SAGE THERMAL GAS MASS FLOW METER

User Manual

For General Purpose Style Models SIG and SRG

DOCUMENT NUMBER 100-0067
REVISION 09 - SIG/SRG (GENERAL PURPOSE)

Make the Wise Choice.
Choose Sage Flow Meters.

SAGE
METERING, INC.

SAGE METERING, INC.
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Tel 831-242-2030
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continued on next page

Welcome

We are pleased that you have purchased a Sage Metering Mass Flow Meter for your requirement. We hope that you are satisfied with the performance, operation and design of our highly precise, NIST traceable Thermal Gas Mass Flow Meter.

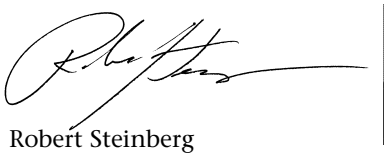
Sage Metering is your source for monitoring, measuring and controlling the gas mass flow in your industrial process, building management system or environmental application. Our high performance, NIST Traceable,Thermal Mass Flow Meters will help increase productivity, reduce energy costs, maximize product yields, and/ or help reduce environmental insult. Sage provides high quality In-Line and Insertion Thermal Mass Flow Meters for a wide variety of industrial, commercial, and environmental monitoring needs, including carbon credit verification for Greenhouse Gas reduction.

Sage Meters measure mass flow directly — there is no need for ancillary instrumentation such as temperature or pressure transmitters. Furthermore, our instruments have exceptional signal sensitivity, have no moving parts, require little if any maintenance, have negligible pressure drop and have a turndown up to 100 to 1, and resolve as much as 1000 to 1. Sage Flow Meters can measure and control the mass flow rate and consumption of air, oxygen, natural gas, nitrogen, digester gas, biogas, flare gas, hydrogen, argon, carbon dioxide and other gases and gas mixes.

The innovative Sage design (whether configured as an In-Line or Insertion Flow Meter) provides high accuracy and repeatability for optimum measurement and control of your process and offers a large-format back-lit display of mass flow, total and temperature. Isolated 4-20mA outputs of flow and temperature are standard. In addition, pulsed outputs of consumption are available off of the Relay contacts. Furthermore, the Sage Meter includes a user-friendly Touch Display Screen keypad and powerful menuing system to integrate the functions of flow measurement with your specific needs. For even greater flexibility, multiple channels (up to four calibrations) are available in one meter.

Please let us know if we can assist you in any way with your Sage Meter, or if you have any questions about its installation, operation, or features. Simply phone us at 866-677-SAGE (7243), or visit our website at www.sagemetering.com to contact a factory representative in your area. (To access this manual on the website, enter in the user name “sage” followed by the passcode “7243737” when prompted.)

Sincerely,



Robert Steinberg
President

Section A

GETTING STARTED

Getting Started

UNPACKING YOUR SAGE METER

Your Sage flow meter is a sensitive, yet rugged, precision built electronic instrument. Upon delivery, care should be taken when opening the shipping container and removing your meter. The meter should be inspected for any damage that may have occurred during transit. If damage is found, please contact the carrier immediately to place a claim for damaged goods. The contents of the container should be checked against the packing list for any discrepancies. If there are any questions as to the contents or configuration of the equipment including calibration ranges, or, mounting hardware, contact Sage Metering as soon as possible. Please save shipping container and packaging materials (including PVC tube probe protector on Sage Insertion Flow Meters) in case the unit needs to be returned for any reason.

MAINTENANCE

Sage thermal mass flow meters essentially require little or no maintenance. While the sensing element is somewhat resistant to dirt and particulate build up, it may become necessary to clean it from time to time if mounted in extremely dirty environments. NOTE: ALWAYS DISABLE THE TRANSMITTER POWER SUPPLY PRIOR TO ANY CLEANING OR MAINTENANCE. A detergent or appropriate non-corrosive solvent for removing the buildup may be required. A soft brush can be used to gently clean the sensing element's surface, using caution to avoid damaging the sensor elements (the RTDs). If any disassembly is necessary, contact Sage Metering, Inc. for instructions. **In general, it is recommended that your Sage Thermal Mass Flow Meter be returned to the factory if cleaning, repair, or recalibration is needed. This is usually the most cost-effective and reliable alternative.**

CALIBRATION

Sage thermal mass flow meters have built-in diagnostics. The menuing system (see Section D) has provisions to check the sensor's operation by accessing the sensor's output and comparing it to the original reported "zero flow" value noted on the last few lines of your meter's Certificate of Conformance. This diagnostic procedure not only checks the sensor performance and the "live zero" calibration point, but it verifies that the sensor is clean. It essentially provides a means to validate the meter's performance, verifies that there is no shift or drift, and eliminates the need for annual factory calibrations. See "Sensor Functionality and Zero Calibration Self Check" on page 44.

CAUTION Cable glands shipped with unit are for shipping purposes only. Remove shipping cable glands before installing.

CAUTION If installing in a Class I hazardous location the installation must comply with appropriate electrical codes.

CAUTION Installer must supply proper ground and bond wire for the transmitter and the sensor per appropriate electrical codes

INSTALLATION AND MOUNTING

- Check the Certificate of Conformance included with your Sage Thermal Mass Flow Meter for system pressure, temperature, gas composition, power input, and signal output.
- It is recommended that the flow meter be inserted in a location of maximum straight run. It is suggested that there be a minimum of 15 pipe diameters of straight run upstream, and 5 diameters downstream, depending on the conditions. **See chart on page 12**. Note, obstructions such as valves, blowers, expanders and PVC and HDPE pipes will require additional straight run (contact factory for assistance).
- Check the orientation: Standard calibration flow direction is left to right when facing the flow meter. Gas flow direction is marked with an arrow on in-line flow meters; UPSTREAM is marked on insertion probes.
- Do not rotate probe, or errors may occur. If enclosure is facing incorrectly, rotate the enclosure 180˚, but do not rotate the probe. The UPSTREAM mark still needs to be facing Upstream.
- Hook up the system per the wiring diagram provided with your Sage flow meter. Double check that wiring for the proper power and signal connections are correct.
- Check that all plumbing and electrical hook-ups are in accordance with OSHA, NFPA, and all other safety requirements.
- **For Remote Style Meters (SRG) be sure the Remote Electronics is matched with the Transducer's Junction Box and its attached Probe or Flow Body. There will be Metal Serial Number Tags on both the Transducer as well as the Remote Electronics enclosure. Do not mismatch the serial numbers of the Remote Electronics and the Junction Box, or calibration errors will occur.**

LOCATING PROPER WIRING DIAGRAM

1) Look at the sticker on your meter. The first three digits describe the basic model that you have. Refer to the appropriate page numbers below for your wiring diagram
2) SIG: See page 17
3) SRG: See page 17 for input/output terminals; see page 19 (Junction Box Wiring Terminals for Remote Style Meters) and page 20 (Circuit Board Layout for General Purpose Meter)

WIRING OF THE SERIES SIG AND SRG

(SEE PAGES 17, 18, 19 & 20)

1) Unscrew lid capture screws (4 locations) on top of clear lid on SIG style; and loosen the latch on lid of SRG fiberglass enclosure.
2) Lift lid: Completely remove clear lid on SIG; and fully hinge back the lid on SRG fiberglass enclosure.
3) Carefully hinge back (top to bottom direction) the exposed board stack to full open position. (This stack consists of the Display Panel and Meter Board, and Relay Board.)
4) The full open position will expose the plug-in headers/wiring terminals on the underside of the top edge of the Meter Board.
5) Full access to wiring is available. (Removal of lug-in headers will facilitate wiring.)
6) Reverse the above steps (1 to 5) in order to seal enclosure.

SELF-POWERED 4-20mA OR USER POWERED 4-20mA

Please note, Sage Meters are not loop powered. The 4-20mA outputs can be Self-Powered or User-Powered. All Sage Meters ship set up for Self-Power. A jumper is pre-installed to bring 24 VDC to the 4-20mA outputs. If you require isolated 4-20mA outputs, the Terminal Hook-Up Drawings will instruct you to remove the jumper and connect to different terminals. In addition, in the User-Powered Mode, you will need to supply separate power for the 4-20mA circuit (between 9 and 27 volts DC).

INSERTION FLOW METER APPLICATION

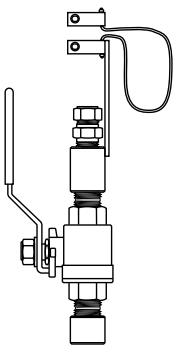
FLOW PROFILE AND INSTALLATION CONSIDERATIONS

Insertion Flow Meters, although generally easier to install that In-Line Flow Meters, require proper installation, and a well developed flow profile, in order to perform properly. Please refer to the section on the following pages titled PROBE INSERTION GUIDELINE DRAWING (page 14) and INSTALLATION DEPTH CHART (page 15).

SAGE VALVE ASSEMBLY OPERATION

Valve assemblies (SVA05) are an optional mounting hardware available through Sage Metering Inc. (see page 34 and 35). They allow the removal of insertion-style meters for service, cleaning, re-calibration, relocation, etc. without the need to "shut-down" your process. The probe insertion depth is adjustable to permit sensor to be located at center to optimize measurement accuracy. (Refer to PROBE INSERTION GUIDELINE DRAWING and CHART, pages 14 & 15.) The ball valve will seal off leaks of the process gas at the point of insertion after the probe assembly has been removed. The assembly includes a valve, threadolet, compression fitting with Teflon ferrule, a cable restraint, and two collar clamps.

A threaded half coupling (3/4" FNPT) properly sized to accommodate the isolation valve retractor assembly must be fitted to the pipe/duct to which the insertion probe will be inserted. **Avoid T-Fittings, since they will disturb the flow profile, and effectively reduce the measurement area.** Direct threading together (or with necessary bushings) of the retractor assembly may be required. In other cases, the threadolet must be welded in place and a clearance hole must be drilled through the pipe/ duct to accept the probe assembly. **If the pipe/duct is under pressure during installation, a hot tap drill (not available through Sage Metering) may be required.**



NOTE: Detailed Drawings are shown on page 34 and 35.

IN-LINE FLOW METER APPLICATION

IN-LINE FLOW METERS

In-line mounting styles are available through Sage Metering, Inc. in sizes from 1/4" pipe through 4" pipe. Threaded male NPT ends are standard. ANSI 150lb flanged ends are optional, all commonly requested on 3" and 4" models. Contact the factory if optional end mounting styles are required. Pipe sizes in excess of 4" require the insertion style mass flow meter.

The in-line style flow meter assembly flow section is typically specified to match the user's flow conduit and is plumbed directly in the flow line by threading, flanging, welding, etc. DO NOT USE REDUCERS. It includes the sensing element (a self-heated flow sensor and a temperature/reference sensor) mounted directly in the specified flow section for exposure to the process gas; a sensor drive circuit; microprocessor meter board, and transmitter enclosure.

All in-line Flow Meters, 1/2" and up have built-in Flow Conditioners. See Table on page 12 for Upstream Straight run requirements. Note, the 1/4" and 3/8" do not have Flow Conditioners and thus require more straight run.

FLOW CONDITIONING

Although a minimum of 15 pipe diameters of upstream straight run is commonly recommended, to absolutely assure that the flow profile is well developed at the point of measurement, either use Flow Conditioners (standard in Sage In-Line Flow Meters, 1/2" and larger, and also available as assemblies for Insertion Flow Meters, see page 13), or consider additional straight run. The Chart below provides examples of the amount of straight run that would virtually assure that there are no flow disturbances at the point of measurement.

IMPORTANCE OF FLOW CONDITIONING
Recommended Pipe Diameters Upstream

DISTURBANCE	WITHOUT FLOW CONDITIONING	*WITH* FLOW CONDITIONING[1]
	Minimum Industry Recommendation	Sage Recommendation
One 90˚ Elbow	15	3
Two 90˚ Elbows in the same plane	20	5
Two 90˚ Elbows in different planes	At least 40	9
4:1 Area Reduction	15	3
4:1 Area Expansion	At least 30	10
Multiple Disturbance	To Be Determined	TBD

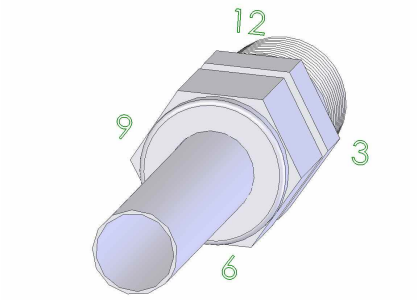
1 This column applies to In-Line Flow Meters, which come standard with built-in Flow Conditioners, as well as Insertion Meters, when provided with upstream Captive Flow Conditioners (see page 13).

COMPRESSION FITTING

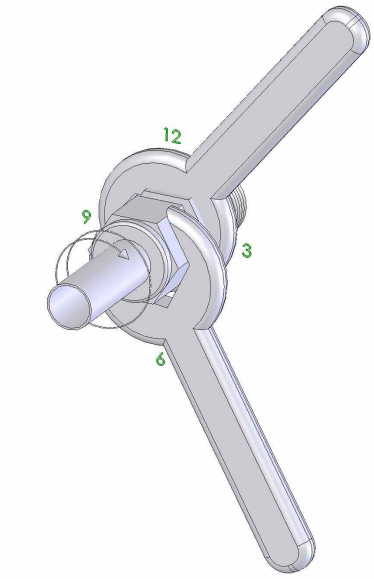
A bored through tube fitting, properly sized to accommodate an insertion probe's particular OD, can be provided by the user or purchased as an option from Sage Metering (see page 34). Prior to installation, a clearance hole to accommodate the insertion probe assembly must be drilled in the pipe/duct. A fitting (1/2" FNPT) is then welded in place or threaded into the half-threadolet which has been welded to the pipe/duct. The probe insertion depth is adjustable to permit sensor to be located at center, to optimize measurement accuracy. (Refer to PROBE INSERTION GUIDELINE DRAWING and CHART, pages 14 &15.)

INSTALLATION INSTRUCTIONS

1. Insert tubing into the tube fitting.
2. Make sure that the tubing is positioned properly per the PROBE INSERTION GUIDELINE DRAWING AND CHART, pages 14 &15.
3. **Due to the variations of tubing diameters, a common starting point is desirable. Therefore, tighten the nut until the tubing will not turn by hand or move axially in the fitting.**
4. Scribe the nut at the 6 o'clock position.
5. While holding fitting body steady, tighten the nut 1¼ turns to the 9 o'clock position.



Insert the probe shaft tubing into the compression fitting to the position indicated in the Probe Insertion guidelines.



While holding the fitting body steady, tighten the nut one and one-quarter turns to the 9 o'clock position.

Probe Insertion Guideline Drawing[1]

INSERTION FLOW METER APPLICATION

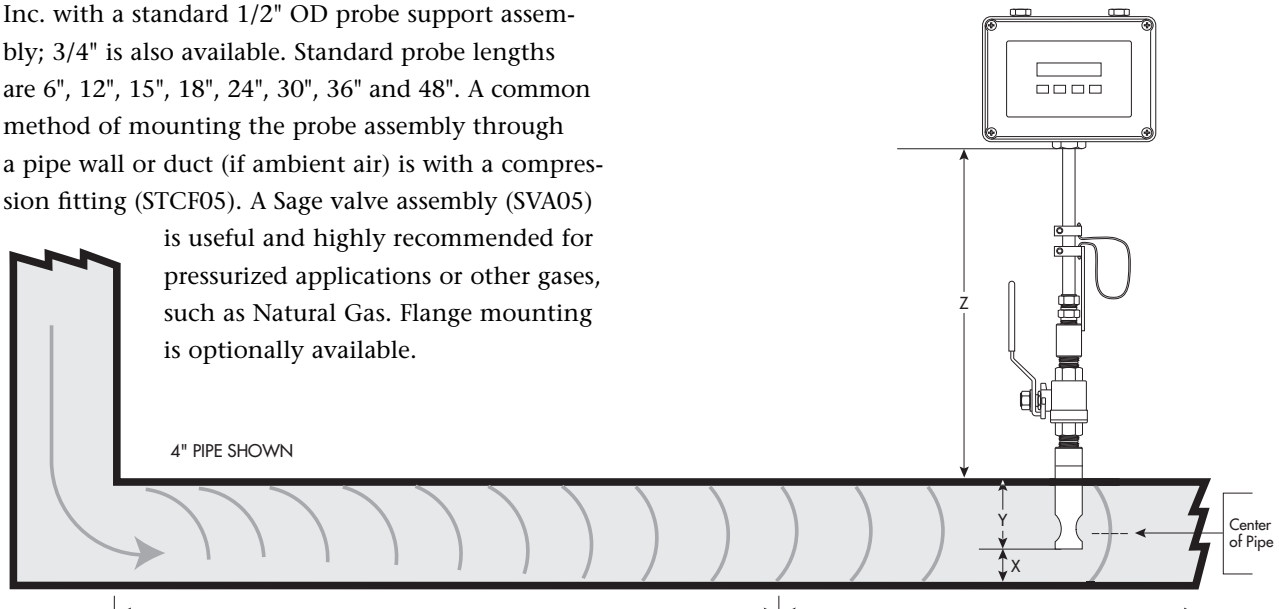
Choose the longest straight-run section of pipe available to allow a uniform, well-developed flow profile. Allow for a minimum of 15 pipe diameters of straight run upstream, and 5 diameters downstream, depending on the conditions. **See chart on page 12**. Note, obstructions such as valves, blowers expanders and PVC and HDPE pipes will require additional straight run (contact factory for assistance). Avoid, if possible, installations immediately downstream of bends, fans, nozzles, heaters and especially valves, or anything else installed in the line that may cause nonuniform flow profiles and swirls. Otherwise signal output errors could result, unless significantly more straight run is provided, or in the absence of sufficient straight run, Flow Conditioners (page 12) are installed (contact Sage for assistance if needed). Refer to page 12 to see the benefits of incorporating Flow Conditioners.

Insertion styles are available through Sage Metering, Inc. with a standard 1/2" OD probe support assembly; 3/4" is also available. Standard probe lengths are 6", 12", 15", 18", 24", 30", 36" and 48". A common method of mounting the probe assembly through a pipe wall or duct (if ambient air) is with a compression fitting (STCF05). A Sage valve assembly (SVA05) is useful and highly recommended for pressurized applications or other gases, such as Natural Gas. Flange mounting is optionally available.

Sage insertion style flow meters can be assembled and calibrated for use in virtually any size pipe or duct (as small as 1″). Sage insertion flow meters include a probe assembly that supports the sensing element (a self-heated flow sensor and a temperature/reference sensor); a sensor drive circuit; microprocessor meter board, and transmitter enclosure. The probe assembly must be inserted into the correct position in the process gas flow conduit to allow the gas to flow through the sensor "window" across the sensor element. The "sensing point" or active part of the sensor (0.5" from the end of the probe) should be positioned as per the drawing below and the Installation Depth Chart on page 15.

INSTALLATION DEPTH

The center of the pipe (assuming a well developed turbulent flow profile) is fairly flat, and easy to locate. See "Installation Depth Chart" on next page to determine proper insertion depth.



1. SIG Industrial Meter shown in drawing.
2. Probe should be inserted per Installation Depth Chart (see following page), so sensors are in the center of the pipe.
3. The portion of the probe that remains outside of the pipe, is simply the factory ordered probe length (i.e. "-15" = 15 inches) minus the "Y" dimension.

Installation Depth Chart

METHODS FOR PROBE INSERTION TO PIPE CENTER

METHOD 1

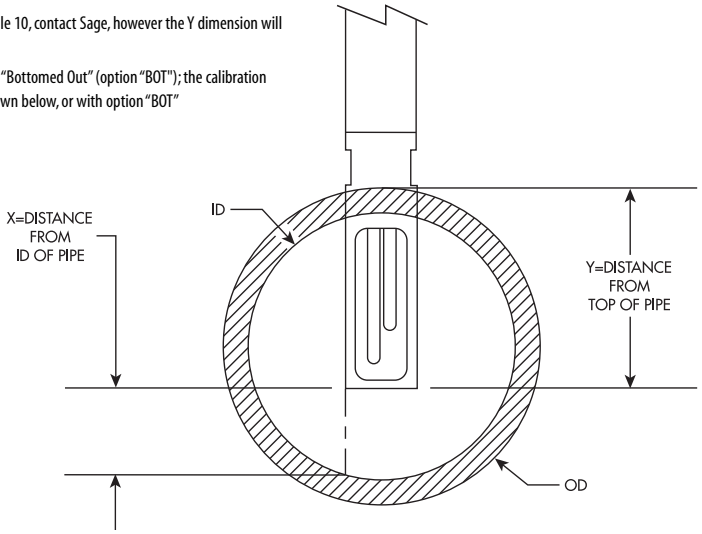
Using charts below, select pipe size (column 1), determine X. Insert probe until the end touches the bottom of the pipe (ID), mark probe as it exits top of fitting. Lift probe distance "X" and tighten compression fitting.

METHOD 2

Using charts below[1], select pipe size (column 1), determine Y. Subtract Y from the factory supplied probe length. That difference should be outside of the pipe, and is measured from the bottom of the probe weld to pipe OD.

1 For other Pipe Schedules, such as Schedule 10, contact Sage, however the Y dimension will be the same for any Schedule Pipe

2 The 1" Pipe Size needs to have the Probe "Bottomed Out" (option "BOT"); the calibration method for the 1½" Pipe is either as shown below, or with option "BOT"

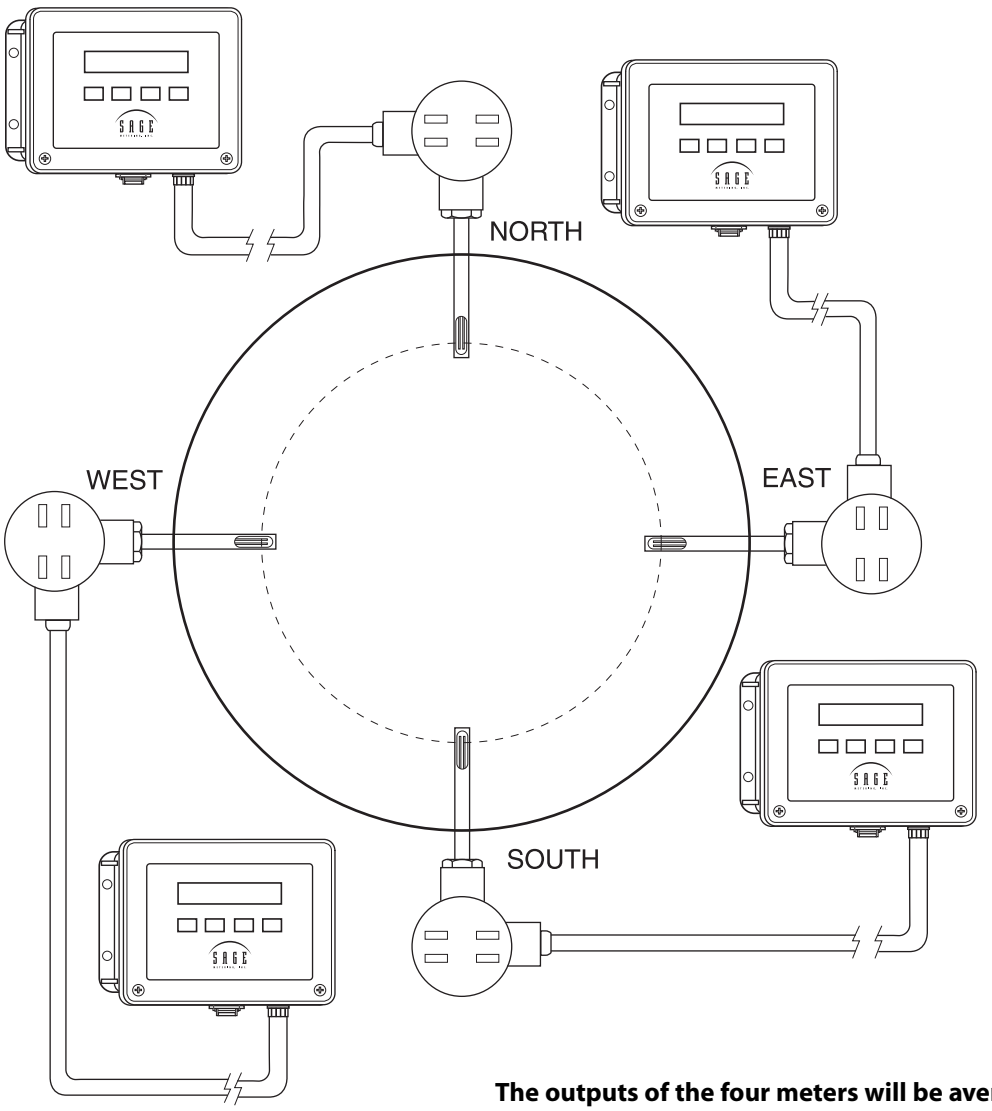


SCHEDULE 40 PIPE[2]					
PIPE SIZE	OD	ID	X	Y	PIPE AREA
1"	CONSULT FACTORY				
1.5"	1.900	1.610	.20"	1.56"	0.0141
2"	2.375	2.067	.40"	1.82"	0.0233
2.5"	2.875	2.469	.60"	2.07"	0.0332
3"	3.500	3.068	.90"	2.38"	0.0513
4"	4.500	4.026	1.40"	2.86"	0.0884
6"	6.625	6.065	2.40"	3.95"	0.2006
8"	8.625	7.981	3.40"	4.90"	0.3474
10"	10.750	10.020	4.40"	6.00"	0.5476
12"	12.750	11.938	5.50"	7.00"	0.7773
14"	14.000	13.124	6.00"	7.50"	0.9394
16"	16.000	15.000	7.00"	8.60"	1.2272
18"	18.000	16.876	8.00"	9.60"	1.5533
24"	24.000	22.625	10.75"	12.60"	2.7919

SCHEDULE 80 PIPE[2]					
PIPE SIZE	OD	ID	X	Y	PIPE AREA
1"	CONSULT FACTORY				
1.5"	1.900	1.500	.15"	1.56"	0.0123
2"	2.375	1.939	.35"	1.82"	0.0205
2.5"	2.875	2.323	.55"	2.07"	0.0294
3"	3.500	2.900	.80"	2.38"	0.0459
4"	4.500	3.826	1.30"	2.86"	0.0798
6"	6.625	5.761	2.25"	3.95"	0.1810
8"	8.625	7.625	3.25"	4.90"	0.3171
10"	10.750	9.750	4.25"	6.00"	0.5185
12"	12.750	11.374	5.13"	7.00"	0.7056
14"	14.000	12.500	5.70"	7.50"	0.8522
16"	16.000	14.312	6.60"	8.60"	1.1172
18"	18.000	16.124	7.50"	9.60"	1.4180
24"	24.000	21.562	10.25"	12.60"	2.5357

Configuration for Utilizing Four (4) Sage Insertion Mass Flow Meters for Large Round Pipes or Ducts Larger than 36" to Minimize Effects of Varying Flow Profiles

(IT IS RECOMMENDED THAT FACTORY BE CONTACTED TO ASSIST WITH APPLICATIONS OF THIS NATURE)

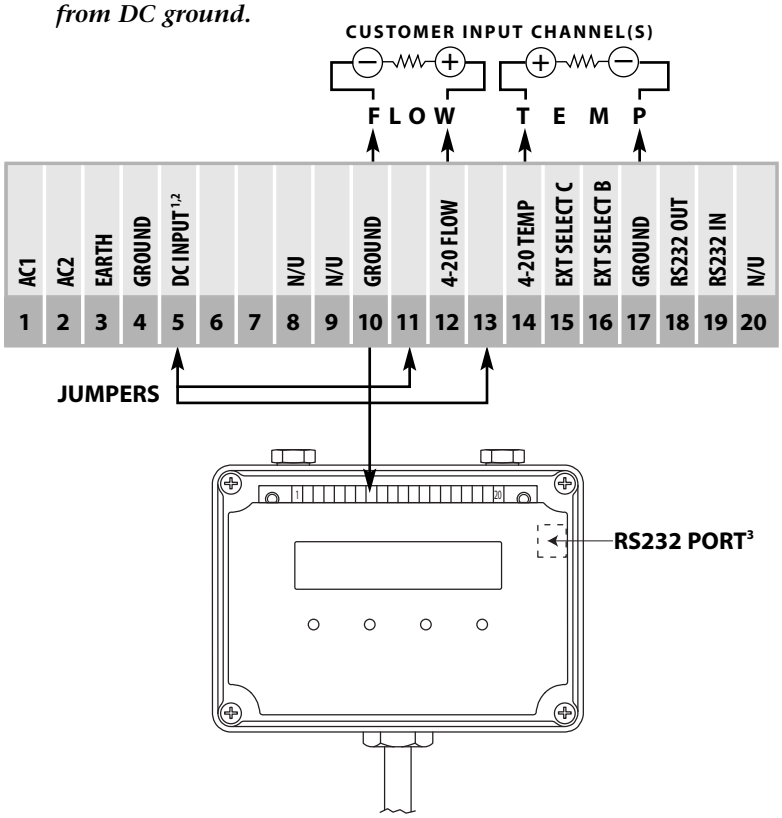


The outputs of the four meters will be averaged by customer's PLC or other method to improve overall accuracy in measuring the flow rate. (For medium sized round pipes [18" to 36"], two meters, on the opposite side of the same diameter, may be sufficient [insert parallel to an upstream 90 degree bend for optimal benefit.]) Note, in this configuration, each sensor needs to be averaged.

Terminal Hook-Up Series SIG, SRG TWO CONFIGURATIONS SHOWN BELOW

1 SELF-POWERED (Internally Powered) 4-20mA (Factory Default)

Sage supplies the power. In this mode ***outputs are not isolated from DC ground.***



NOTE: Terminals 5 & 11 are jumpered to provide power for the FLOW 4-20mA outputs. For FLOW output, connect your device between Terminal 12 and return to any ground. Terminals 5 & 13 are jumpered to provide power for the TEMPERATURE 4-20mA outputs. For TEMP output, connect your device between Terminal 14 and return to any ground.

OUTPUTS ARE NOT ISOLATED IN THIS MODE *(see below for opto-isolated outputs).*

MULTIPLE CHANNELS
(ALSO SEE ITEM 701 ON PAGE 47)

External Select B:
Ground for Channel B

External Select C*:
Ground for Channel C

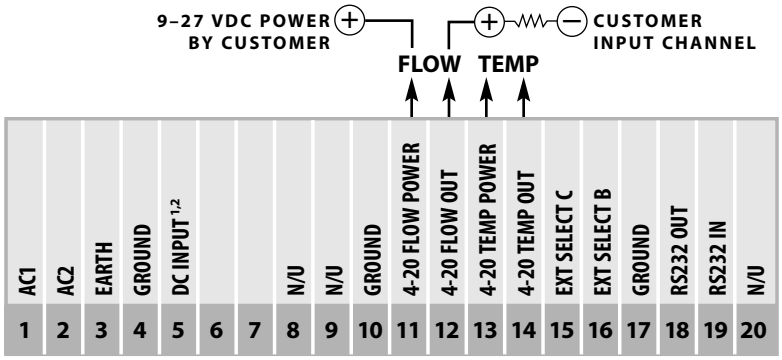
Ground Both for Channel D

NOTE: Item 701 must be set to External Mode (4) to enable terminals for Channel Selection

***Optionally External Select C can be programmed to clear the Totalizer, but not if Menu 701 set up for External Mode (either Externally Select Channels, or Externally Clear Totalizer, not both)**

2 USER-POWERED (Externally Powered) 4-20mA

User supplies the power for the 4-20mA outputs after first removing Jumpers from Terminals 5 and 11 and 5 and 13. ***Outputs are opto-isolated.***



NOTE: When Jumpers 5 & 11 and 5 & 13 are removed, the user must supply power to the 4-20mA outputs (9-27 volts). Note, the meter also needs to be powered (24 VDC or 115 VAC/230 VAC). Connect your device as shown for fully isolated floating outputs.

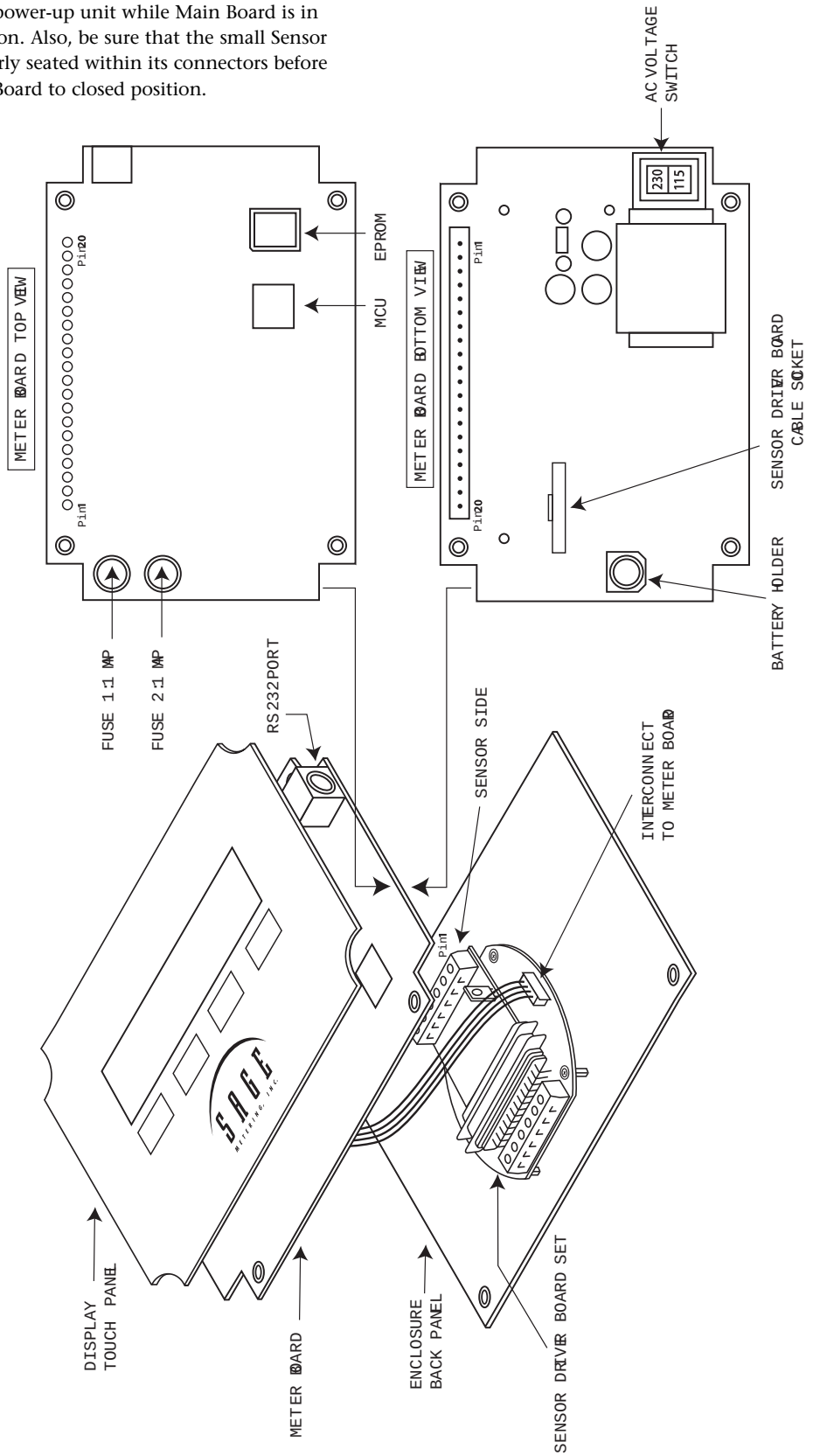
See page 21 for further information on RS232 cable/connector interface.

In this User-Powered mode, the 4-20mA outputs can be reversed and will still operate properly.

1 Typically 24VDC. **NOTE:** AC POWERED METERS DO NOT REQUIRE ADDITIONAL POWER. DO NOT APPLY 24VDC TO TERMINAL 5 ON METERS THAT ARE ORDERED FOR AC OPERATION.
2 24 Volt Power Supply must supply at least 350 ma (unless display back light is turned to Auto [Item 707]), in which case 250 ma is adequate.
3 Cover needs to be opened to access.

Circuit Board Layout for General Purpose Style Meter

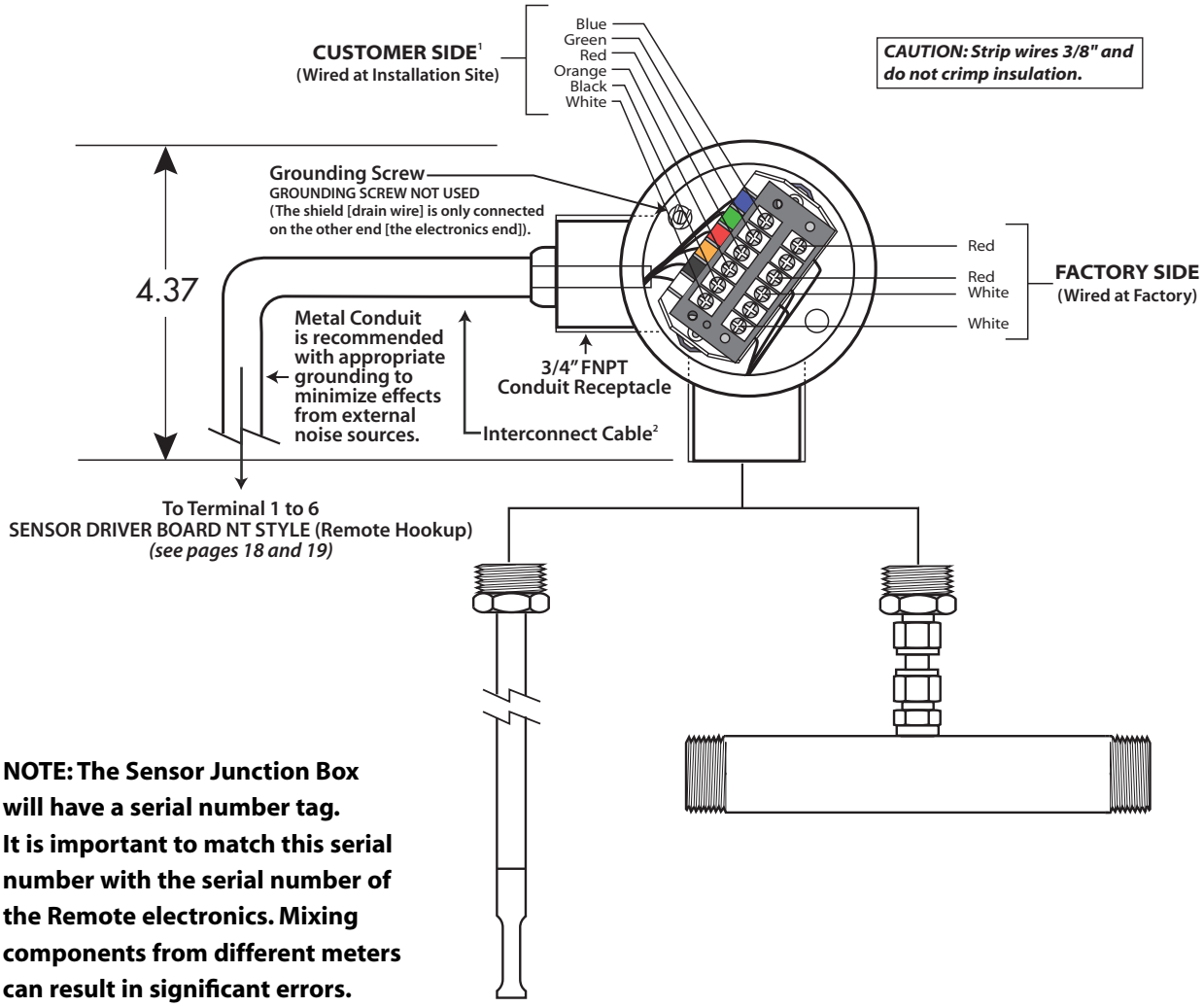
WARNING: Do not power-up unit while Main Board is in open (hinged) position. Also, be sure that the small Sensor Drive Board is properly seated within its connectors before returning the Main Board to closed position.



Junction Box Wiring Terminals for Remote Style Meters (Series SRG)

(THERE ARE NO ELECTRONICS INSIDE JUNCTION BOX)

SEE THE FOLLOWING PAGE FOR THE OTHER END OF THE REMOTE WIRING HOOKUP (the electronics side).



NOTE: The Sensor Junction Box will have a serial number tag. It is important to match this serial number with the serial number of the Remote electronics. Mixing components from different meters can result in significant errors.

1 CSA standards require grounding this end as well. Refer to proper electrical code: **CEC Part 1 Appendix J18-100.**

2 **NOTE:** There are hidden jumpers (underneath the terminal strip) that short together the Blue and Green wires, and also short together the Black and Orange wires. These extra wires are part of the meter's Lead Length Compensation circuitry, allowing the user to change the length of the interconnect cable (from 0 to 1000 feet) without effecting the accuracy. 25 feet of cable are initially supplied (for cabling longer than 1000 feet, contact Sage).

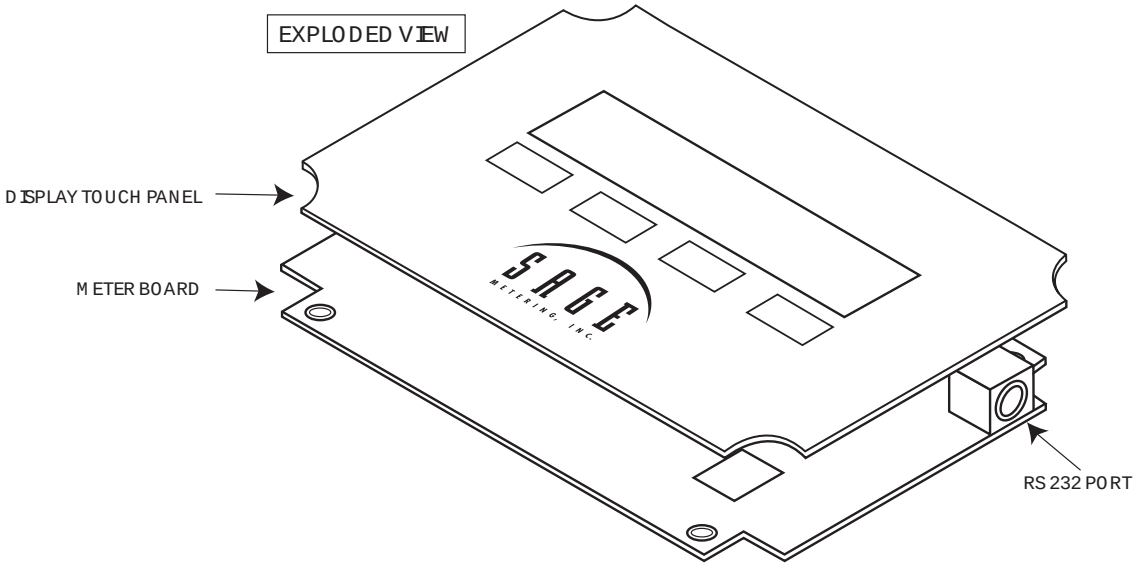
3 Sage supplies 25 feet of cable for the interconnect wires between the Junction Box and the Remote Enclosures: Carroll (manufacturer), Part #C0783, 20 gauge, 6 conductor, foil shielded, grey PVC jacket.

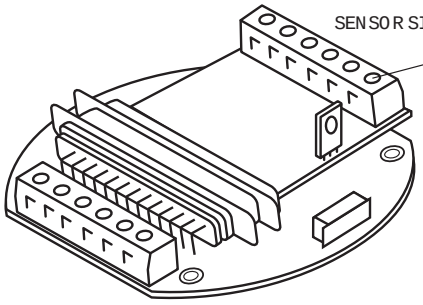
CAUTION: Cable and cable glands are not for use in hazardous area environments. Power, ground, outputs, shielded cable, seal fittings and conduits are to be supplied by customer.

Circuit Board Wiring for General Purpose NT Style Meters

(DO NOT MISMATCH SERIAL NUMBER OF ELECTRONICS WITH SERIAL NUMBER ON JUNCTION BOX SENSOR)[1]

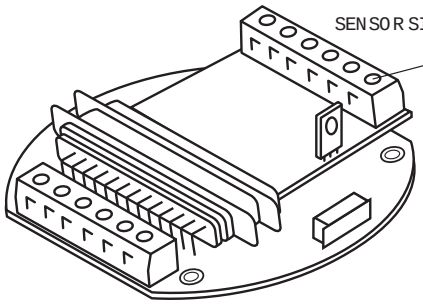
WARNING: Do not power-up unit while Main Board is in open (hinged) position.





SENSOR DRIVER BOARD NT STYLE
REMOTE HOOKUP (Factory Pre-Wired)
(Connected to Junction Box [Customer Side] via a 6-conductor interconnect cable. See previous page.)

6 – Orange (Temperature & Sense Return)
5 – Black (Temperature Sense)
4 – White (Temperature Send)
3 – Blue (Flow & Sense Return)
2 – Green (Flow Sense)
1 – Red (Flow Send)

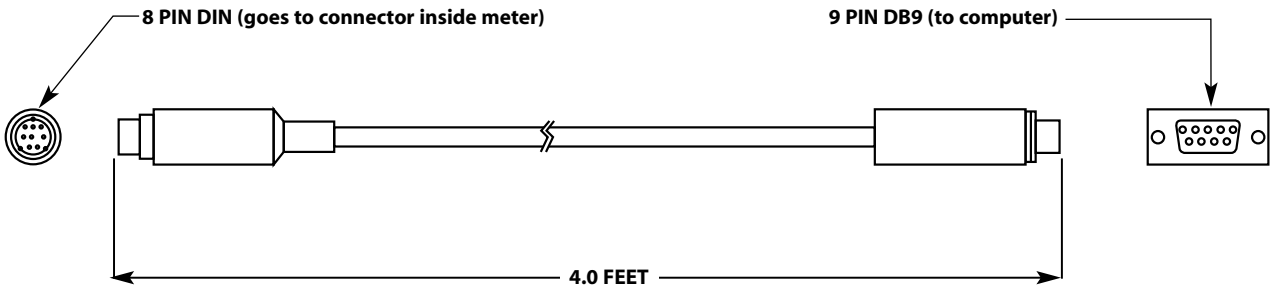


SENSOR DRIVER BOARD NT STYLE
INTEGRAL HOOKUP (Factory Pre-Wired)

6 – White (Temp)
5 – N/C
4 – White (Temp)
3 – Red (Flow)
2 – N/C
1 – Red (Flow)

1 A Sage Thermal Mass Flow Meter with remote electronics is a custom calibrated meter. All components (sensors, electronics, boards, etc.) are matched-sets that share the same serial number and *MUST BE INSTALLED TOGETHER AS A SYSTEM.* **Mixing components from different meters can result in significant errors/malfunctions.**

RS232 Cable Connector Assembly

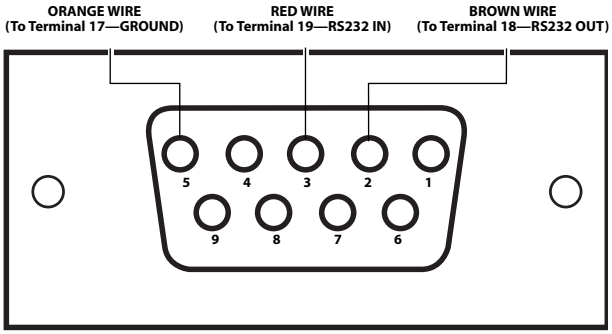


Optional Connection to Main Terminal

The assembly shown above is for temporary RS232 connectivity to the meter's mating 8 pin connector. The meter's cover needs to be removed while connected. The other end, of course, goes to your laptop via its RS232 DB9 connector.

Optionally, you can connect directly to the RS232 terminals on the main terminal strip. (See pages 17 and 18.) You can procure your own RS232 cable assembly with fly leads for the meter's terminals and a DB9 for your laptop. However, it may be easier to simply cut off the unneeded 8 Pin DIN connector from the cable assembly, and strip the appropriate color wires as shown below. Then simply run the cable and its stripped wires through one of the meter's access ports (cord grips) to the appropriate terminals.

RS232 HOOKUP FOR SIG & SRG SERIES[1]



1 **Note:** If meter appears not to be communicating, you can momentarily short pins 2 and 3 on the Com port of the computer to see an "Echo". If there is an "Echo", connections are correct.

Section B

STYLES AND FEATURES

Styles and Features

THERMAL MASS FLOW METERS

Sage Thermal Mass Flow Meters are designed for high performance mass flow measurement of flow rate and consumption of gases such as natural gas, air, oxygen, digester gas, landfill gas, biogas, gas mixes, flare gas, nitrogen, carbon dioxide, oxygen and hydrogen.

Sage Metering has distinguished itself by offering a higher standard – our mass flow meter output is unaffected by even large process temperature variations, and our digital electronics is impervious to external analog noise. Fast response, high resolution, and ultra sensitivity are features that are at the heart of every Sage Thermal Mass Flow Meter.

All Sage meters, depending on product style, can be reconfigured in the field (contact Sage for details concerning software and related accessories). In addition, all meters have a convenient in-situ field diagnostic procedure that verifies that the original factory calibration hasn't drifted, shifted, or changed. This "Sensor Functionality and Zero Self Check" also verifies that the sensor is free from contamination, even without inspection. All Sage Flow Meters are offered in the Integral Style or Remote Style (with lead-length compensation up to 1000 feet) with explosion proof Junction Box with your choice of Probe or Flow Body depending on your pipe size.

HOW DOES THERMAL MASS FLOW MEASUREMENT BENEFIT YOU?

- Direct Mass Flow—No need for separate temperature or pressure transmitters
- High Accuracy and Repeatability—Precision measurement and optimal control of your process
- Turn down of up to 100 to 1 and resolution as much as 1000 to 1
- Low-End Sensitivity—Detects leaks, and measures as low as 5 SFPM!
- Negligible Pressure Drop—Will not impede the flow nor waste energy
- No Moving Parts—Eliminates costly bearing replacements, and prevents undetected accuracy shifts
- Dirt Insensitive—Provides sustained performance
- Low cost of ownership
- Ease of Installation and Convenient Mounting Hardware

Features and Benefits

The innovative Sage design features an easy-to-use menuing system, a large format mass flow, total and temperature display, and easy-to-use, Touch Display Screen, 4-button keypad to integrate the functions of flow measurement with your specific needs. You will have the flexibility to use the local display/keypad, or a laptop, to change configurations or to conduct basic diagnostics, including a calibration self-check, with a simple routine using the keypad. At any time you can use the convenient menuing system to change full scale values, digitally filter the flow signal, change decimal points, set Low Flow cutoffs, check diagnostics, or reconfigure an insertion meter for a different pipe size.

continued on next page

In addition, you can order your meter configured for up to four different gas calibrations, and simply select the desired channel (A-D) at any time (e.g. four different gases, sensitivities, or configurations). Or you can order the meter calibrated for one gas (e.g. compressed air), but have it pre-configured for up to four different pipe sizes and full scales, so you can simply select the desired channel (A-D) based on the application. Channels are totally independent and each have their own full scale accuracy statement and settings.

There are numerous other features built in to most Sage Flow Meters including the SIG/SRG Series. For example, continuous tracking of the highest and lowest mass flow rate with built in time and date stamps. This is a very practical feature for determining unusual peaks in a gas process, or for identifying excess usage by certain departments. Sage meters provide the average flow rate for the prior hour at any time. If you require relay outputs, the meter includes two independent, 1 amp SPDT relays which can be configured by laptop for a variety of settings, including trip-high, trip-low (with or without relays), window alarms, pulsed outputs, timer outputs, etc.

The Series SRG includes a more robust latched 9.3"x7.3" Fiberglass Remote Enclosure that can be mounted 1000 feet away from the sensor's measurement point. The 6-conductor cable separating the sensor probe (or flow body) from the electronics is lead-length compensated, allowing the user to change wire length without affecting the meter's accuracy or performance. In addition, the probe has an Explosion Proof Junction Box that does not require any electronics (all the electronics, as well as the meter display and menuing Touch Display Screen keypad, are in the Remote Enclosure). Thus, this easy-to-wire Junction Box is suitable for harsh environments (see drawing on page 19).

Sage also offers an OEM version of our proven, high performance gas mass flow meter product line (Series SIL or SRL). "Sage Lite" has many features of the standard product line, but does not have a display, does not have a menuing keypad, does not support multiple channels, and does not support relay outputs. However it has linear outputs of flow rate and temperature or an optional configuration for pulsed outputs of totalized flow. It is offered in a 5x5x4 NEMA 4X enclosure, or Explosion Proof Enclosure, or as a single circuit board for customized end-user packaging.

Sage also offers Sage Prime Thermal Mass Flow Meters (Series SIP or SRP) or the Explosion Proof Series (Series SIE or SRE). Contact Sage for details. If there are any features that you require, or if you need application assistance, feel free to contact our local factory trained representative in your area. Refer to www.sagemetering.com, or phone the Sage Sales or Service Staff to assist you (866-677-7243).

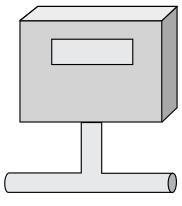
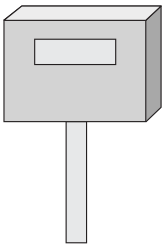
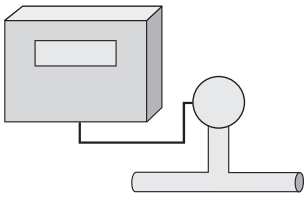
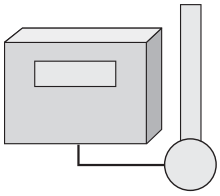
Principle of Operation of the Thermal Mass Flow Meter

Sage Thermal Mass Flow Meters have two sensors constructed of reference grade platinum windings (RTDs). The two RTDs are clad in a protective 316SS sheath and are driven by a proprietary sensor drive circuit. One of the sensors is self-heated (flow sensor), and the other sensor (temperature/reference sensor) measures the gas temperature. The pair is referred to as the sensing element, and is either installed in a probe as an Insertion style, or inserted into a pipe section as an In-Line style flow meter.

As gas flows by the flow sensor, the gas molecules carry heat away from the surface, and the sensor cools down as it loses energy. The sensor drive circuit replenishes the lost energy by heating the flow sensor until it is a constant temperature differential above the reference sensor. The electrical power required to maintain a constant temperature differential is directly proportional to the gas mass flow rate and is linearized to be the output signal of the meter.

It is essential that this constant temperature differential be maintained, even if there are wide fluctuations in gas temperature. It is the "job" of the Sage proprietary sensor drive circuit to maintain the differential, whether or not the gas temperature changes, or however quickly molecules cool off the flow sensor. It is also necessary to properly calibrate the device with the actual gas (or close equivalent with certain gases), in the Sage National Institute of Standards certified (NIST) calibration facility. By accomplishing these two critical objectives, the Sage meters provide an extremely repeatable (0.2% of full scale) and accurate output directly proportional to the mass flow rate of the gas being measured.

BASIC GENERAL PURPOSE SAGE FLOW METER STYLES

SIG SERIES – INTEGRAL		SRG SERIES – REMOTE	
IN-LINE	**INSERTION**	**IN-LINE**	**INSERTION**
			
SIG-XXX	**SIG-XX-XX**	**SRG-XXX**	**SRG-XX-XX**

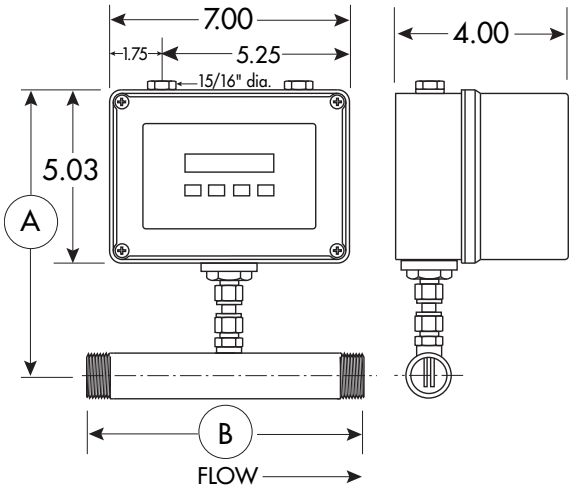
Section C

DRAWINGS

SIG Series Integral Style General Purpose Mass Flow Meters

IN-LINE STYLE[1,4]

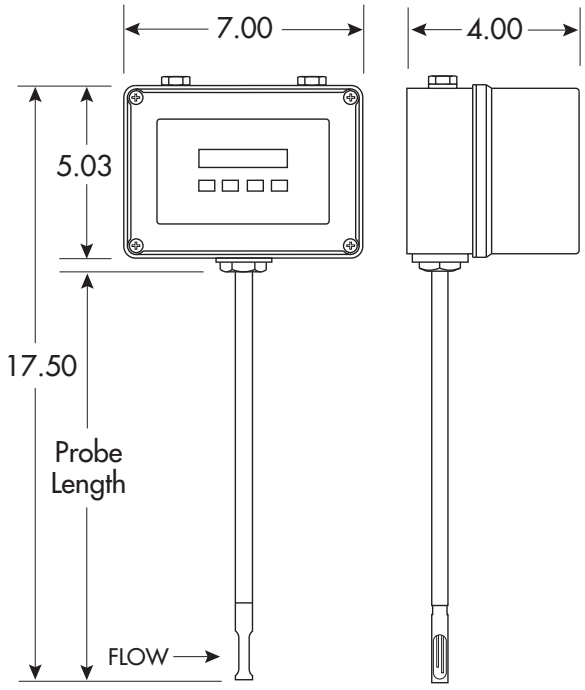
NEMA 4X Enclosure. 150#, 300#, or 600# flanged ends are optionally available. (1" Flow Body Shown.)



IN-LINE METER DIMENS	
Pipe Size x Flow Body Length (B)	Gen. Purpose (A)
1/4" x 6"	8.03"
3/8" x 6"	8.09"
1/2" x 7"	8.15"
3/4" x 7"	8.28"
1" x 8"	8.40"
1-1/4" x 10"	8.53"
1-1/2" x 12"	8.65"
2" x 12"	8.90"
2-1/2" x 12"	9.15"
3" x 12"	9.40″
4" x 12"	9.90"

INSERTION STYLE[2,4]

NEMA 4X Enclosure. 150#, 300#, or 600# flanged mounting is optionally available. Available probe lengths are 6", 12", 15", 18", 24", 30", 36" or 48".



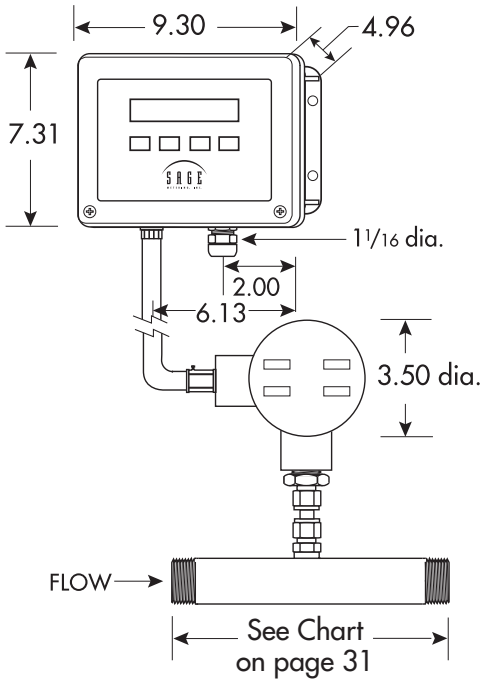
1 NPT Fittings standard.
2 Flanged Mounting available for high pressure operation.
3 Flow Conditioning built in to Flow Meter Pipe Sizes 1/2" and up. Contact Sage for optional 1/4" tube flow body.
4 Meter has two 1/2" NPT access holes.

SRG Series Remote Style General Purpose Mass Flow Meters

IN-LINE STYLE[1,3,4,5]

In-line style has not been CSA approved for hazardous area

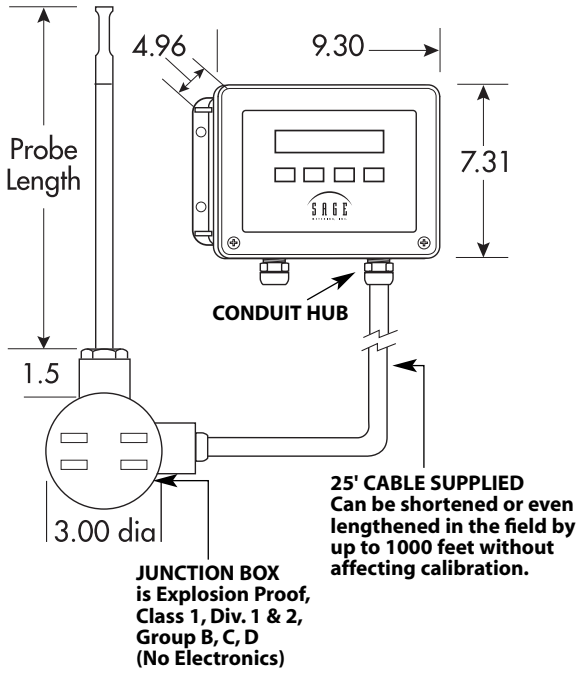
NEMA 4X Enclosure. 150#, 300#, or 600# flanged ends are optionally available. (1" Flow Body shown.)



INSERTION STYLE[2,4,5]

This enclosure not rated for hazardous area environments

NEMA 4X Enclosure. 150#, 300#, or 600# flanged mounting is optionally available. Available probe lengths are 6", 12", 15", 18", 24", 30", 36" or 48".



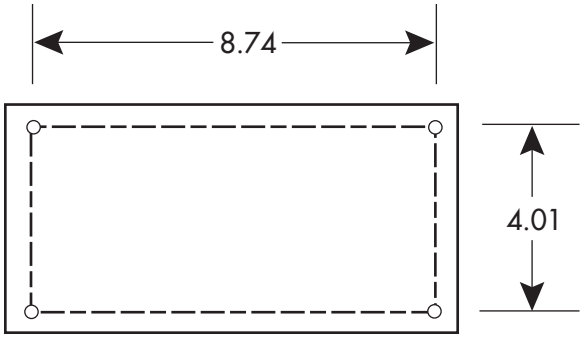
1 NPT Fittings standard.
2 Flanged Mounting available for high pressure operation.
3 Flow Conditioning built in to Flow Meter Pipe Sizes 1/2" and up. Contact Sage for optional 1/4" tube flow body.
4 Meter has two 1/2" NPT access holes.
5 Junction Box has the following certifications: Class I, Groups B,C,D; Class II, Groups E,F,G; Class III; 4X, 7BCD, 9EFG; FM Standard 3615; UL Standard 1203; CSA Standard C22.2 No. 30; and NEMA Compliance

⚠ CAUTION: Cable and cable glands are not for use in hazardous area environments. Power, ground, outputs, shielded cable, seal fittings and conduits are to be supplied by customer. CSA approved installations must comply with CEC Part 1 Appendix J18-100

JUNCTION BOX
Class I, Group B, C, D
Class II, Group E, F, G
NEMA 7 & NEMA 9

Wall Mounting Procedure for Remote General Purpose Enclosure

A 6-32 Pan Head Phillips machine screw is recommended for each corner of the SRG remote enclosure. The screw will have to pass through .296 inches (roughly 19/64") of overall thickness at the bottom of the enclosure mounting hole before the screw threads emerge. The thickness of the enclosure material is 1/8". The over-all length of the screw depends on the customers mounting configuration and how much depth they have to penetrate on their mounting plate that the enclosure is being fastened to.

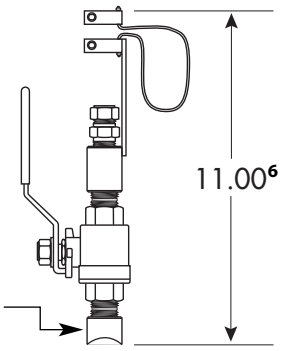


DIMENSIONS ABOVE ARE FROM HOLE CENTER TO HOLE CENTER

Mounting Hardware[3]

SVA SERIES ISOLATION VALVE ASSEMBLY FOR INSERTION METERS[4]

Used for pressures to 250 psig[1] (shown for use with 1/2" diameter insertion meters). Available sizes are 1/2" x 3/4" NPT (SVA05 shown), and 3/4" x 1" NPT for use with 3/4" diameter insertion meters (SVA07).

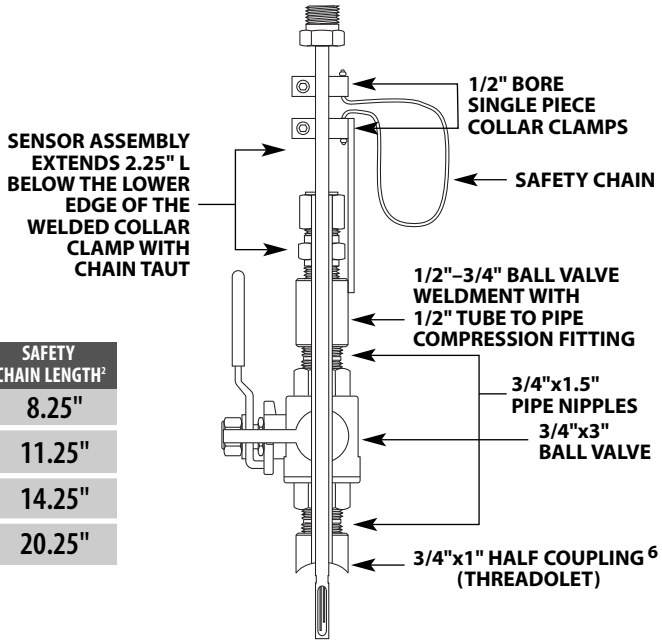


PROBE LENGTH (with sensor)	SAFETY CHAIN LENGTH[2]
12"	8.25"
15"	11.25"
18"	14.25"
24"	20.25"

NOTE: User needs to weld a 3/4" female threadolet (of appropriate radius) to mate with existing pipe after a 3/4" hole has been drilled in pipe. The 3/4" Male Coupling of the Sage Isolation Valve assembly will thread into the user's 3/4" threadolet.

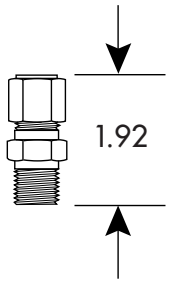
SVA SERIES ISOLATION VALVE ASSEMBLY DETAIL[5]

Cut away view of probe inserted through isolation ball valve assembly.

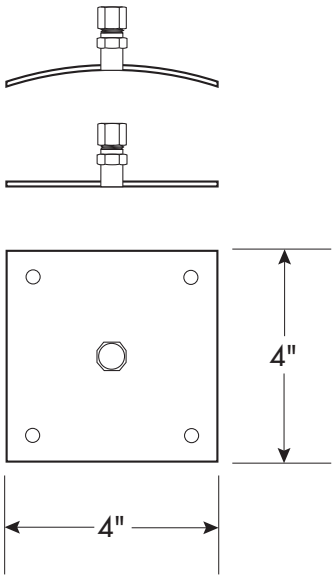


STCF SERIES TEFLON FERRULE COMPRESSION FITTING

1/2" tube x 1/2" MNPT pipe fitting (shown, not to scale), is used for low pressure insertion applications to 125 psig (Stainless Steel Ferrule optional for higher pressure applications – up to 650 psig[1]). Also available in 3/4" tube x 3/4" pipe size.

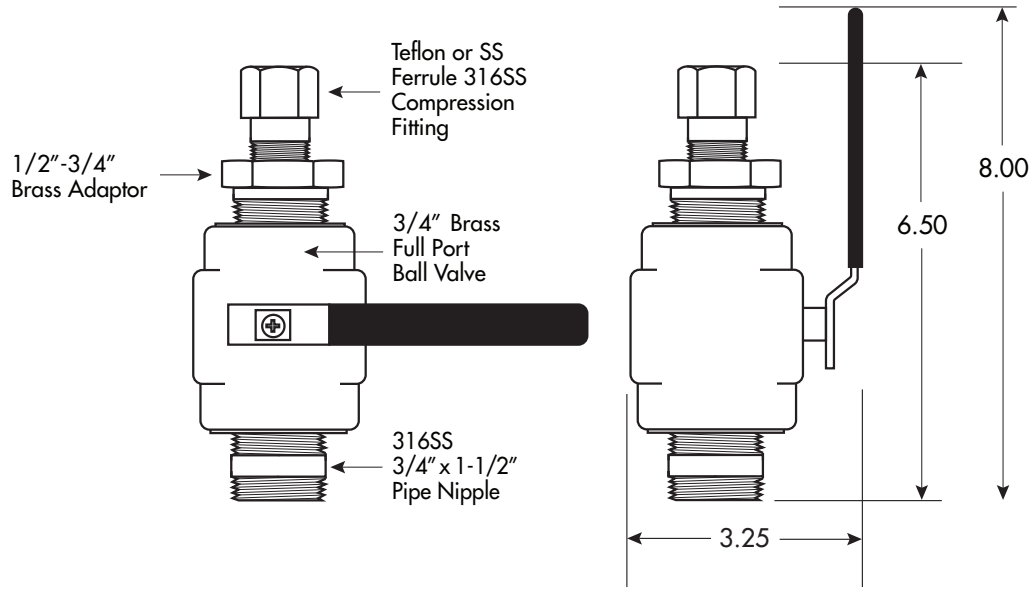


MOUNTING PLATE FOR THIN WALLED DUCTS (INCLUDES STCF05 COMPRESSION FITTING)



1 At 250 psig, force exerted on 1/2" diameter probe is 50 lbs.
2 Safety chain is designed to prevent probe from accidentally escaping from assembly during removal from pressurized pipe.
3 Insertion meters can have optional flanged mounting (generally used for high pressure or very hot gases). This adaptation is not shown. Consult factory for details.
4 Maximum gas temperature, 200F, unless high temperature models ordered.
5 Hot Tapping is feasible by removing Weldment (upper portion of assembly temporarily removed).
6 Height of SVA07 is 12.50". Also, the SVA07 requires a 1"x1½" Threadolet.

SVA05LP LOW PRESSURE ISOLATION VALVE ASSEMBLY

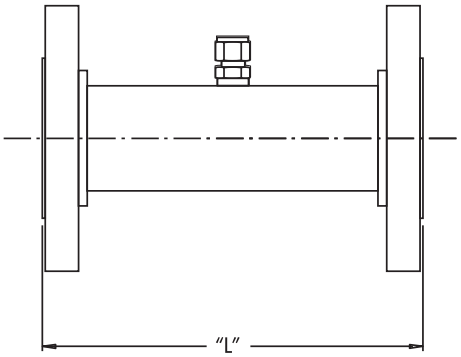


NOTES AND CAUTIONS

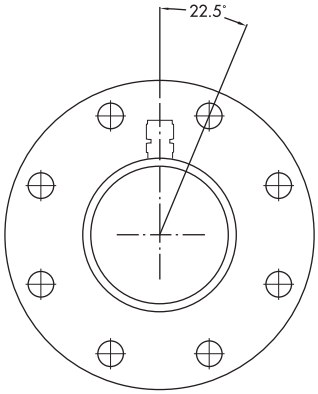
- **Suitable for low pressure Air or Natural Gas applications (maximum 50 PSIG)**
- **Assumes ½" Insertion Probe inserted to center of a Pipe (see Sage Probe Insertion Guidelines)**
- **Teflon Ferrule permits ease of Probe insertion or removal**
- **Exercise caution when loosening Ferrule nut during insertion and removal of Probe, since this model has no Safety Chain**
- **Note, maximum upward force is 20% of pipe pressure (i.e., 10 Lbs with 50 PSIG)**
- **The Assembly will be shipped with a plastic sleeve that protects the 3/4" pipe nipple**
- **It is the Customer's responsibility to weld a Female Threadolet with correct diameter to pipe**

Optional Flanges

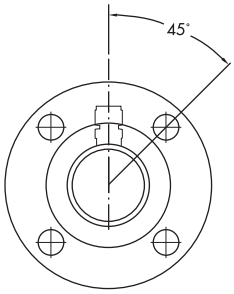
Flanged Ends (150#, 300#, or 600#) are optional on In-Line Flow Meters. Otherwise, NPT Ends are supplied. The Face-to-Face dimensions ("L") of Flanged Ends are identical to the lengths shown on the Table on page 31. The table on page 31 applies either to the standard NPT terminations or the Flanged Ends.



SIDE VIEW



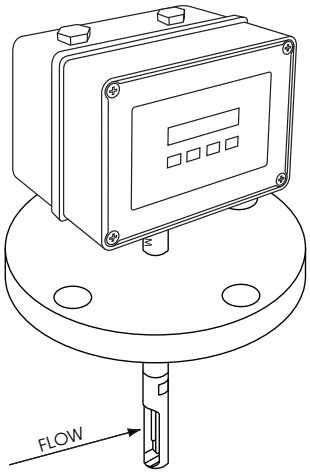
Flanges for 3½" pipe sizes and up, have 8 bolt holes



Flanges for 3" pipe sizes and smaller have 4 bolt holes

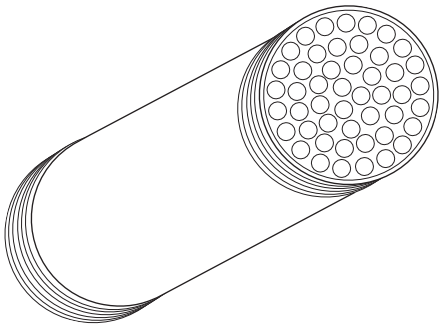
BOLT PATTERN

Flanged mounting for Insertion Flow Meters is also optional, although generally applied to very high pressure or high temperature applications only. Note, when specifying Flanged mounting for Insertion Flow Meters, the Flange will be welded. Therefore it is essential that a drawing is supplied that clearly shows the height of the mating Flange relative to the Pipe OD. The Pipe ID and Schedule will also be required. Sage will fabricate Flanged Insertion Meter so that the sensor lines up with the center of the pipe when the Sage Flange is bolted to the customer's Flange.

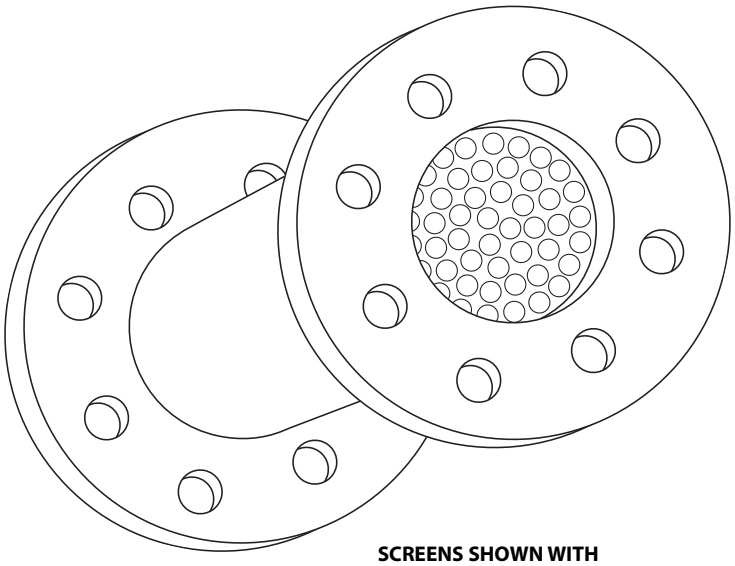


FLANGED MOUNTING FOR INSERTION METER

In-Line Flow Conditoning Screens (STANDARD FOR FLOW BODIES 1/2" AND UP)

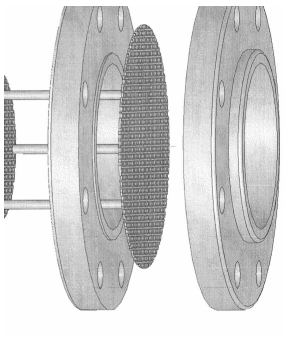


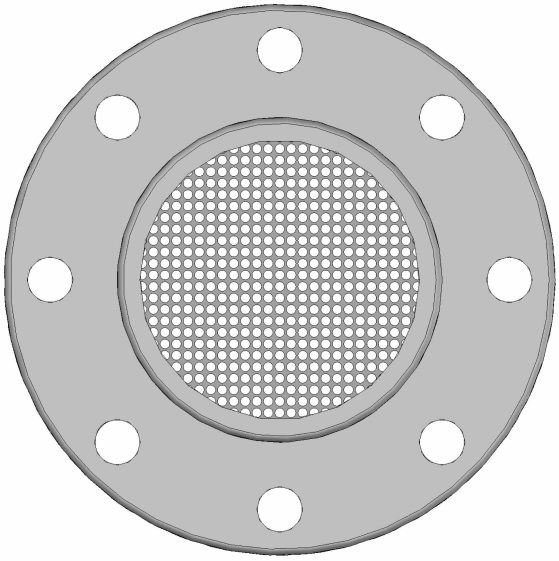
SCREENS SHOWN WITH NPT FITTING.



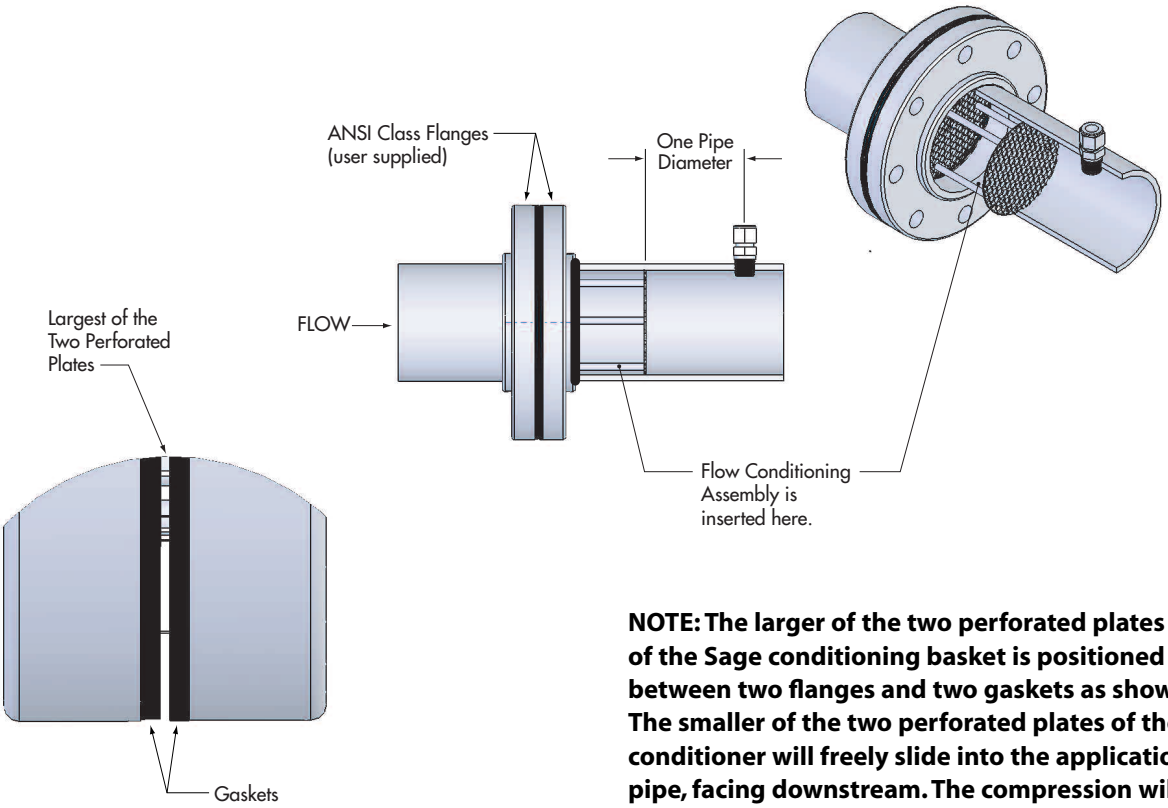
SCREENS SHOWN WITH OPTIONAL FLANGED ENDS

Optional Captive Flow Conditioners (FOR INSERTION FLOW METER APPLICATIONS[1])





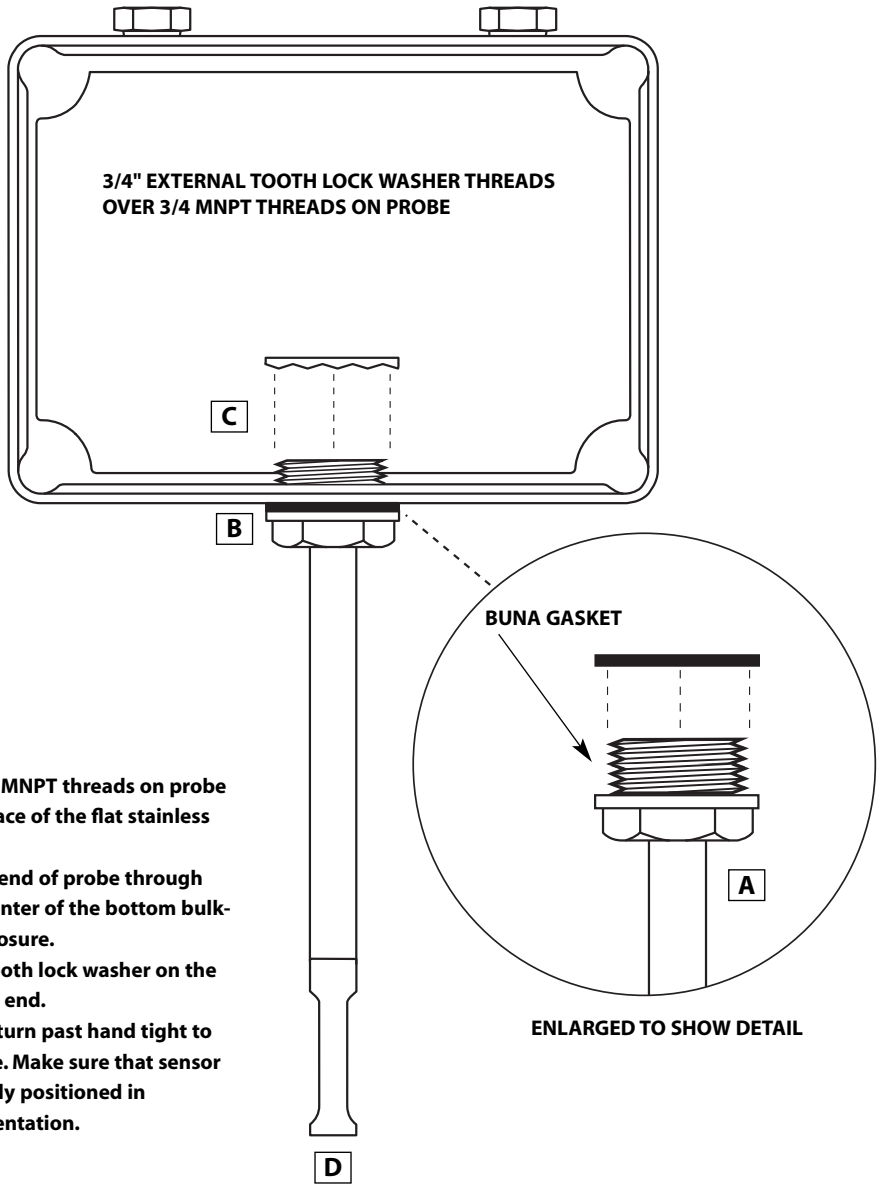
FRONT VIEW OF ONE OF THE CONDITIONING PLATES



NOTE: The larger of the two perforated plates of the Sage conditioning basket is positioned between two flanges and two gaskets as shown. The smaller of the two perforated plates of the conditioner will freely slide into the application pipe, facing downstream. The compression will be placed one diameter downstream of the downstream plate.

1 Insertion Flow Meters need to be calibrated for Flow Conditioners; either order Flow Conditioners at same time as Insertion flow meter, or use suffix FC1DIACAL in the flow meter Part Number.

General Purpose Probe and Transmitter Head Assembly Procedure



ASSEMBLY STEPS

- **A** Slip Buna Gasket over 3/4" MNPT threads on probe so it fits flush against the face of the flat stainless gasket sealing ring.
- **B** Place 3/4" MNPT threaded end of probe through the receiving hole in the center of the bottom bulkhead of the electronic enclosure.
- **C** Thread the 3/4" external tooth lock washer on the 3/4" MNPT threaded probe end.
- **D** Secure probe with 1/4-1/2 turn past hand tight to seal probe support in place. Make sure that sensor window aperture is properly positioned in upstream/downstream orientation.

Section D

USER INTERFACE

Touch Display

IMPORTANT INFORMATION

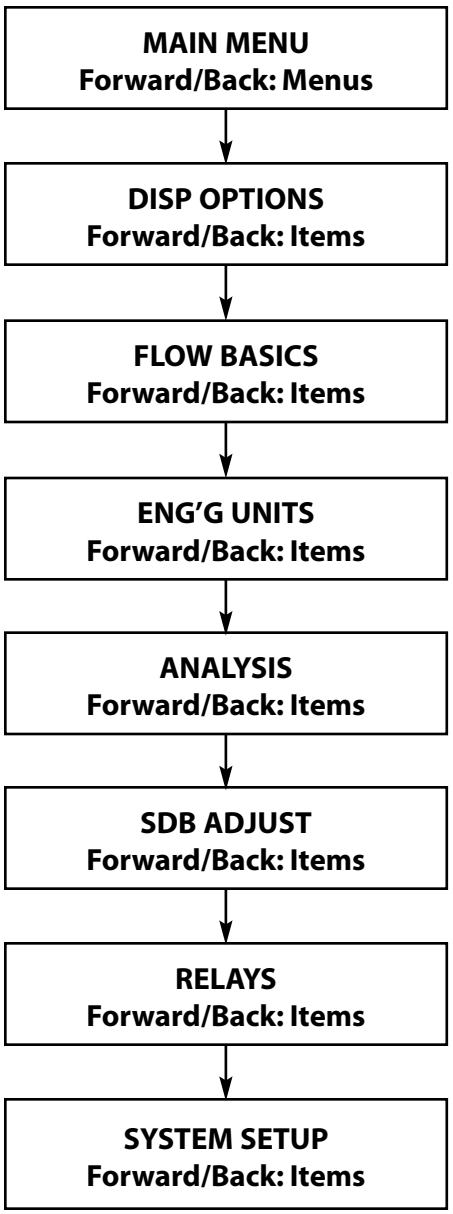
BUTTONS WORK WITH COVER IN PLACE!

- The Sage Touch Display adds a touch sensitive surface to the exterior of the clear lid housing the 9"x7"x4" or 7"x5"x4" Sage General Purpose Meters (SRG or SIG).
- This surface activates the switches by the touch of a finger.
- Metallic or plastic objects will not activate the switches and will be ignored by the Touch Display.
- Operation of the meter without the lid in place is not recommended because of shock hazard.
- A dot will appear on the LCD screen directly above the active button while a finger is present. This will provide feedback to the user indicating that a button press has been recognized.
- Do not rest or touch a finger on any button for more than 10 seconds, or the circuitry will re-calibrate and ignore the "stuck" button.

User Interface (SEE PAGE 46 FOR SIMPLIFIED KEYPAD INSTRUCTIONS)

MENUS

Press **SELECT/SET** button to enter passcode to change item settings; enter 99999. Main Menu (Menu 100) places meter into "Flow Mode", and Flow Rate, Total and Temperature are displayed. This selection also locks settings after any changes have been made.



Sensor Functionality and Zero Calibration Self Check

USE KEYPAD[1]

The SIG and SRG Series Keypad can be used to access the raw calibration milliwatts (mw) as an important diagnostic procedure. At any time, you can check this reading at a "no flow" condition and compare the reading to the original reported "zero flow" value noted on the last few lines of your meter's Certificate of Conformance or the flow meter's data tag. This diagnostic procedure not only checks the sensor performance and the "live zero" calibration point, but it also verifies that the sensor is clean. It essentially provides a means to validate that the meter is operating properly, verifies that there is no shift or drift, and eliminates the need for annual factory calibrations. This simple field diagnostic procedure also verifies that the sensor is free from contamination, even without inspection.

1. Verify that meter has no gas flow[2]
   Close appropriate valves in the process to have a "no flow" condition so you can check the "live zero" mw output of the actual gas (it should be checked at the same pressure as noted on Certificate of Conformance).
   If it is not possible to close valves in the process (e.g. natural gas supply must be kept flowing), a user with a Sage SVA05 or SVA07 Isolation Valve Assembly can check "zero" of the actual gas and pressure without shutting off the gas supply. Refer to SVA SERIES ISOLATION VALVE ASSEMBLY DETAILS ON PAGE 35.
   a) Loosen Lower Collar Clamp completely
   b) Slightly loosen compression fitting until Probe can be lifted
   c) Lift Probe until Safety Chain is taut
   d) Tighten compression fitting
   e) Close Valve
   f) Check zero mw as per "2" below
   Optionally, do an ambient air check by removing probe and covering up sensor by capping the sensor with a plastic bag, empty plastic water bottle or other means of preventing flow (see 8).

2. Assumes you are already in the correct channel. (See example 9, on page 56 if you have a Multiple Channel meter.)

3. Verify that meter is in Flow Mode.

4. If not, refer to Example 2 on page 54.

5. Press Flow/Shift five times (brings up Analysis Menu).

6. Press Forward/Up twice (brings up RTD Power).

7. Press Select/Set once.

8. You are now observing the raw milliwatts (mw) coming off the sensor circuit. Check the observed reading (after a few minutes of "no flow" stabilization), against the last line(s) of your Meter's Certificate of Conformance.

9. A value within 5 milliwatts of the original Factory value (assuming the same gas is checked at same pressure) indicates that the meter is still in calibration.

10. A value greater than 5 milliwatts, but less than or equal to 10 milliwatts, also indicates that the meter is still in calibration, but this reading may have been influenced by one or more of the fol-

lowing factors: gas composition, pressure, dirt, non-zero conditions, and sensor orientation. Any of these factors can have an effect on the mWo (mw zero). It is a very sensitive data point and that is why it is such a good check.

11. Note, if all of the above factors were remedied, it would be expected that the mW zero would report less than or equal to 5 milliwatts.

12. Note, in some cases, contamination of the sensor is the only cause of the additional heat transfer during the “no flow” test. Remove the probe, and clean the sensor (use an appropriate non-corrosive solvent to remove the build up). A soft brush can be used to gently clean the sensing surface, using caution to avoid damaging the sensor elements (the RTD's).

13. In summary, if a technician in the field were able to simulate Sage calibration conditions, he too would find that the mWo would be within one mW or very close to that. Since this is not always possible, we are finding that after considering all of the field variables, a mWo in the field that is within 10 mW is an acceptable value. This would allow for a check to be done in the pipe under application conditions.

14. Note, if desired, a second check can be conducted as well but using ambient air: This validation method requires that the sensor be removed from the pipe and inserted in a container such as an empty plastic water bottle. We would recommend this second check if there is any question at all about the first check (while in the pipe) or if it’s mWo value approaches 10 mW. The sensor should be removed from the pipe, cleaned, and inserted vertically into a clean dry container such as a water bottle. This would allow a field check very similar to the air mWo check that is done at Sage, and more than likely will give the same results that we recorded here at Sage.

1 Keypad is best to use, since the milliwatts is in real time (it continuously changes). You can use laptop, if necessary, but Menu 505 (RTD Power) is just a "snapshot" of the milliwatts. Nevertheless, the laptop can be used, if more convenient.

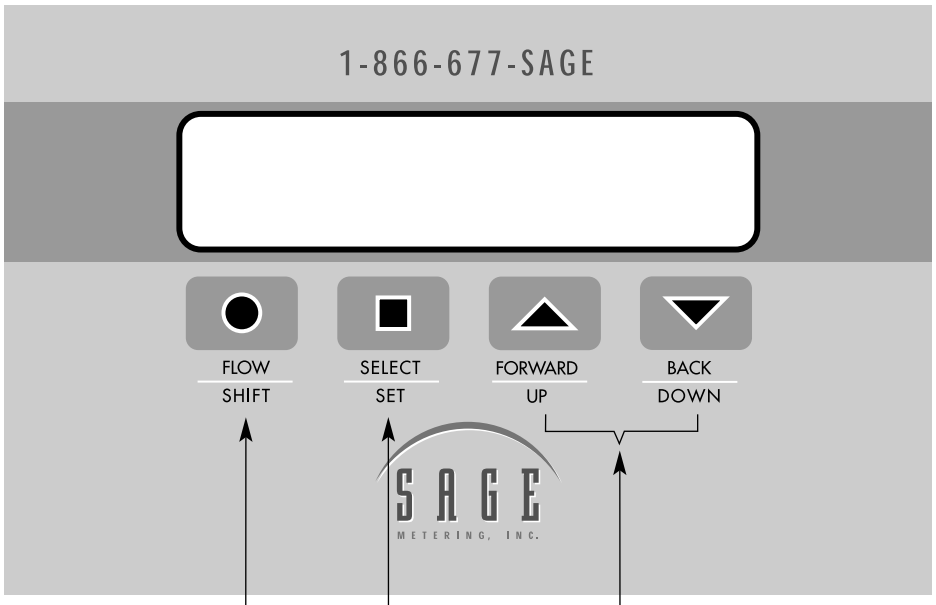
2 Sage "zeros" the meter in a horizontal pipe. If you have a vertical pipe, mW will be slightly lower at zero (also see note 4).

Simplified Keypad Instructions

(SEE PAGE 51 FOR DETAILED KEYPAD NAVIGATION AND MENUS)

The normal display is "Flow Mode", where Flow Rate, Total, and Temperature are displayed. To make changes, see chart below.

Sage Touch Screen Technology is on General Purpose Meters (SIG, SRG). The cover does not need to be removed to access the Menuing System.



❶ Press first to bring up Menus. (PRESS REPEATEDLY TO VIEW ALL MENUS.)

❷ Press second to bring up Items within a Menu. (PRESS REPEATEDLY TO VIEW ALL ITEMS.)

❸ Press third to view Contents of Items
OR
Press after Passcode entered to change settings.

❹ Press again to toggle out of Contents

OR

❶ Press first to bring up Passcode (Enter 99999) to unlock settings.
(PRESS "BACK/DOWN" THEN "SELECT/SET". REPEAT SEQUENCE FIVE (5) TIMES THEN "SELECT/SET" TO ACCEPT.)

IMPORTANT SHORTCUTS

To return to "Flow Mode", simply hold "Forward/Up", then press "Flow/Shift" (unless viewing Contents). This also locks settings.

To view Serial Number and software revisions, press "Back/Down" when in "Flow Mode".

To switch Channels when in "Flow Mode" (if you have a Multiple Channel meter), tap "Back/Down" 4 times (in under 3 seconds), and then tap "Flow/Shift" for Channel A, "Select/Set" for Channel B, "Forward/Up" for Channel C, or "Back/Down" for Channel D.

For additional shortcuts, see Common Shortcuts on page 51.

VIP Menus and Items—Rev. 2.06

SUITABLE FOR WINDOWS XP™ OR VISTA™ OPERATING SYSTEMS

(SEE PAGES 49–50 FOR MENU ITEM DESCRIPTIONS)

Sage VIP Software[1,2] (Ver. 2.06) is supplied with each order, along with an RS232 Cable/Connector. (**NOTE:** VIP Software can also be downloaded off of the Sage Metering Website, www.sagemetering.com. Click on "Manual/ Downloads" Tab, and select "Click to Download VIP Rev 2.06". The user name is "vip", and the passcode is "7243737".) Refer to Terminal Hookup Drawings (Page 17) as well as to page 21 (RS232 Cable Connector Assembly). Also, see Appendix (page 77) to view a typical Screen Shot. Connect meter to the DB9 of computer as shown on page 21. If your computer does not have a DB9 Serial Port, then use a USB to RS232 converter. The sequence when using a connector as to when to power on the meter, is important.

1) Turn off the computer
2) Be sure the meter is unplugged (powered down)
3) Connect the RS232 cable to the USB/RS232 connector
4) Turn on the computer
5) After booted up, you can power up the meter
6) Finally, open up the Sage VIP (use space bar to activate it, if necessary). Also drag the bottom of window down to see the full screen

If your computer does have a DB9 Serial Port, then after meter is connected to computer, open up Sage VIP and press space bar to activate Menu System to bring up prompt. To make changes, enter Passcode 99999 at the prompt to unlock, then select item(s) to change. To resume normal (Flow) operation, enter 100 at the prompt. Entering 100 will automatically lock the meter until the Passcode is entered again. Also it is necessary to enter 100 immediately after any channel selection (item 701). If necessary, use "." "Enter" to back out of prompt.

MAIN MENU
100 FLOW METER
200 DISPLAY
300 BASICS
400 ENG'G UNITS
500 ANALYSIS
600 SENSOR DRIVER
620 RELAYS
700 SYSTEM SETUP

200 DISP OPTIONS
201 Rate Prec (0-3)
202 Total Prec (0-2)

210 Max Val (FS=20mA)[3]
211 Min Cutoff
220 Temp Deg (0=Off, 1=F, 2=C)
221 Temp Max (Default: 200F=20mA)
222 Temp Min (Default: 40F=4 ma)
230 LCD Address

300 FLOW BASICS
303 Zero Offset
304 K-Factor[4]
305 Pipe Area (Sq Ft)
306 DO NOT USE (see 619)[5]
307 Reset Total[6]
308 Flow DAC Max
309 Flow DAC Min
310 Temp DAC Max
311 Temp DAC Min
330 SDB Address (30)

400 ENG'G UNITS
499 RESERVED
401 KG/
402 LB/
403 NCM
404 NMP
405 SCC
406 SCF
407 SFP
408 SLP
409–412 Custom Units
420 DAY
421 HOUR
422 MINUTE
423 SECOND

500 ANALYSIS
503 Avg Flow (Per Hr)
504 Avg Temp (Per Hr)
505 RTD Power
506 ACT Flow
507 ADC TV
510 High Flow
511 High Time
512 High Date
520 Low Flow
521 Low Time
522 Low Date
530 Clear Data

600 SDB ADJUST[7]
601 Calib mWatts
602 TempExciteRes
603 TempVRefVolts
604 Temp Amp Gain
605 Temp Cal [A]
606 Temp Cal [B]
607 Temp Cal [A]
608 Temp Cal [D]
609 Temp Disp [A]
610 Temp Disp [B]
611 Temp Disp [C]
612 Temp Disp [D]
613 Flow Coeff [A][8]
614 Flow Coeff [B]
615 Flow Coeff [C]
616 Flow Coeff [D]
617 Flow Coeff [E]
618 Flow Coeff [F]
619 Filter Coeff

620 RELAYS
621 Set RY#1 Off
622 Set RY#1 On
623 Set RY#2 Off
624 Set RY#2 On
625 Spare
630 Disable
631 Trip High Flow
632 Trip Low Flow
633 Trip High Temp
634 Trip Low Temp
635 Total Delta
636 Timer
637 Keypress
638 Delay Time

700 SYSTEM SETUP
701 Chan Sel (0=A,1=B,2=C,3=D, 4=External Mode)[9]
702 Sample Rate (x20 msec)[10]
703 Serial Number (Meter Ser No)
704 New Passcode (Default=99999)
705 Time
706 Date
707 Back Lite (0=Auto, 1=On)
708 Factory All
710 Format EEPROM
711 Backup EEPROM
712 SDB PreCharge
720 Ext. Zero Enable[11]
730 Power Splash[12]
735 Eng. Units Mode[13]
740 Meter Address (50)
750 Passcode

continued on next page

VIP MENUS AND ITEMS (CONTINUED FROM PAGE 47)

[1]If data is not transmitting, select "View" "Settings" to select the active COM port (1-4), then shut down and restart VIP. If necessary, verify that your computer's **Serial Port** has the correct Serial Cable Port Settings. Open Control Panel (Start, Control Panel). Then select System, Hardware, Device Manager, Ports (COM & LPT), Communications, Port Settings.

Bits per Second:	19200
Data Bits:	8
Parity:	None
Stop Bits:	1
Flow Control:	None

[2]If bottom of VIP screen is not visible (i.e., prompt not visible, and flow rate and total and temperature not visible), change computer to a 96 font DPI setting (Control Panel, Display, Settings, Advanced, DPI Settings, 96).

[3]If you change Max Val higher than original (Full Scale) calibration range, you may lose some accuracy since the calibration data is now being extrapolated. However, it allows the Flow Rate Display to continue, and also resets the 4-20mA to the new setting. Contact Sage for details.

[4]K-factor (304) affects display, and recomputes Max Val (210) to maintain original 4-20mA setting. If new 4-20mA setting desired to track display, then change Max Val (210) back to original setting. (i.e., if original Max Value was 100, a K factor of .5 changes Max Value to 50.) See next section for more detail.

[5]Do not change item 306. See item 619 to change filtering. Note item 702 adjusts update period, and often is useful if the issue relates to display or output changing too rapidly.

[6]Reset Total resets the totalizer to zero. If you want to disable the totalizer, see footnote 11 on this page. Also see note 10 on page 65.

[7]Newer versions of the meters may have some changes in Menu 600. Contact Factory for latest version. (***Note:*** *The 600 Menu is primarily used by the Factory, except for item 619 which adjusts filtering [useful to dampen fluctuating flows.])*

[8]If Factory authorizes entering of new coefficients, it is best to use VIP software to enter values in 613 to 618 rather than keypad to prevent truncating of least significant digits.

[9]User may press A,B,C,D (uppercase) in VIP to instantly switch channels.

[10](Low Value=Fast, High Value=Slow, Factory Default=10. Affects display and 4-20mA outputs.)

[11]Clears the Totalizer when Ext Select C terminal is momentarily grounded. To completely disable totalization, then jumper Ext Select C terminal (Terminal 15 SIG/SRG Series to ground).

[12]Provides custom text upon start up.

[13]Provides custom engineering units.

Menu Item Descriptions (SEE PAGES 47 AND 48)

201 Rate Prec—The number of decimal points for the flow rate (top line) reading (max 3).

202 Total Prec—The number of decimal points for the total display (bottom line) reading (max 2).

210 Max Val—Full Scale Setting.

a) This value will recalculate when engineering units are changed. For example, 1000 SCFM Full Scale becomes 60,000 SCFH if the engineering units are changed to SCFH (the change will be observed after the meter is put into "Flow Mode" (the normal mode [100 on laptop, or Keypad Shortcut (hold "Forward/Up," then press "Flow/Shift"]).

b) This value will also recalculate if pipe area is changed. For example, a Full Scale of 100 SCFM in a 6" pipe (.2006 sq. ft.) will have a new full scale of 173.2 SCFM in an 8" pipe (.3474 sq. ft.).

c) At any time you can change the Max Val (Full Scale Value) below the original Full Scale Value, adjusted for the new Engineering units, or below the Full Scale value adjusted for the new pipe area. If you do so, you will have a new lower Full Scale (i.e., the new Value will equal 20mA), and the display will be limited to that value. This change has the effect of lowering the range of the meter. You can raise the Full Scale Value higher than the original calibration value, but in that case the readings may be less accurate (see footnote 3 on page 48). (Note: The original calibration value is noted on the Certificate of Conformance.) In some cases the calibration value may be higher, if for example there is some uncertainty as to the proper Full Scale Value. For example, a customer may request a Full Scale Value of 100 SCFM, but Sage may add an extra 20% of calibration data (to 120 SCFM). In that case, the Full Scale Value can be changed up to 120 SCFM.

d) This value will also recalculate when a K-factor (item 304) is entered. For example, a K-factor of .8 will cause a Full Scale of 100 SCFM to become 80 SCFM. Be careful, however. You will generally want to restore the Full Scale setting back to 100 SCFM by manually changing item 210 back to 100 SCFM, so that 100 SCFM will still report an output of 20mA (see item 304 description). Otherwise, when the display reads 80 SCFM, the output will read 20mA instead of 16.8mA.

211 Min Cutoff (also referred to as Low Flow Cutoff (LFC) or Zero Cutoff)—If it is desired to "force" the meter flow rate to read zero, even if there is a small amount of flow (such as a leak, some gas convection, higher zero pressure then specified), then simply select a value. If for example, your meter is calibrated from 0 to 100 SCFM, by putting a value of 5 in item 211, any flow up to, or equal to 5 SCFM will display 0 (zero), and thus the totalizer will not advance. As soon as the actual flow exceeds 5 SCFM, normal operation is restored. The following applies to the 4-20 ma Scaling: Normally, the 4 ma output corresponds to zero (0) Flow Rate. If, however, a Low Flow Cutoff (LFC) was specified, than the user should set the 4 ma value to the LFC valve. (i.e. If a 0–100 SCFM is set to have a 3 SCFM LFC, then the user should set 4-20 ma to 3 SCFM to 100 SCFM instead of 0 SCFM to 100 SCFM. By not doing so, a slight non-linearity would result). Note, any Flow Rate at or below the LFC valve will read 0 on the display.

220 Temp Deg—This controls whether the displayed temperature reads in Fahrenheit or Centigrade. If "0" is selected, the temperature reading will always be blank. (Note: The temperature readying will also blank if the totalizer exceeds a value that requires 7 digits (i.e., 99999.9 or 9999999). The next count will cause the entire temperature display to blank. (The temperature will be restored once the totalizer is reset, or if the totalizer "rolls over" [exceeds 12 digits]).

221 Temp Max—The Full Scale of the temperature. Example 200˚F=20mA.

222 Temp Min—Example 40˚F=4mA.

230 LCD Address—Factory Only.

303 Zero Offset—Factory Only.

304 K-Factor—1) Used to bias the readout. For example, if meter reads 100, and customer feels 102 is correct, then change K-Factor to 1.02

K-Factor—2) Used to correct gravimetric units (such as LBS/Min, Kg/Sec, etc.) for gases other than Air. Put in the specific Gravity of the gas. For example, for Nitrogen, use 1.037

K-Factor—3) Can be used to correct for for a different Pipe Area than the meter's original set up. For example, if calibrated initially in a 4" Schedule 40 Pipe (.0884 sq. ft.), and then re-installed into a 6" Schedule 40 Pipe (.2006 sq. ft.), enter a K-factor to 2.269 (original factory K-factor was 1.000). Note 2.269 = .2006/.0884. Normally, you'll use item 305 for a pipe change

NOTE: THE K-FACTOR IN THE ABOVE EXAMPLES WILL NOT ONLY BE REFLECTED IN THE DISPLAY, BUT ALSO IN THE 4-20 ma OUTPUT

305 Pipe Area—The pipe area must be changed any time the meter is inserted into a different pipe than originally specified (except for velocity units, such as "SFPM"). For example, if the original pipe area was .2006 square feet (for a 6" Sch 40 pipe), and you decide to insert the meter in an 8" Sch 40 pipe, change the pipe area to .3474 square feet so the SCFM, (or other flow units) will read correctly. This will also change the Full Scale (see "210–b" description). It is best to "Save" (Item 100) immediately after changing pipe area.

306 DO NOT USE (Unless you have Rev. 2.045).

307[1] Reset Total—You can reset the totalizer to zero. Note: by enabling item 720 (Ext Zero Enable), you can reset the totalizer externally. That is, you can reset the totalizer with a contact closure (terminals 15 and 17 on SIG or SRG). It is recommended that you Reset Total if engineering units are changed (i.e. from SCFM, or vice versa, or when channels (calibrations) are changed.

308–311 Factory Only.

330 Factory Only.

400 Change Engineering Units[2].

503 Avg Flow—View the average flow for the past hour.

504 View the average temperature for the past hour.

1 The Totalizer, as well as Trip High and Trip Low Values (items 510 to 522) need to be reset if the channels are changed (see Menu items 307 and 530) if you want to clear those readings.

2 The Totalizer (Item 307) should be reset in some cases (i.e. LBS. to SCF or vice versa).

MENU ITEM DESCRIPTIONS CONTINUED FROM PAGE 49

505 RTD Power—Reports true sensor raw output, and can be used in the Sensor Functionality and Zero Calibration Self Check when using the keypad.

506 ACT Flow—Contact Factory for assistance.

507 ADC TV—Factory Only.

510[1] High Flow—This is the highest flow recorded since the last time the data was cleared. (See 530, Clear Data.)

511[1] High Time—This is the Time stamp when the High Flow was recorded.

512[1] High Date—This is the Date stamp when the High Date was recorded.

520[1] Low Flow—This is the lowest flow recorded since the last time the data was cleared. (See 530, Clear Data.)

521[1] Low Time—This is the Time stamp when the Low Flow was recorded.

522[1] Low Date—This is the Date stamp when the Low Flow was recorded.

530 Clear Data—This clears the High Flow, Low Flow, their Time and Date stamps, as well as Average Flow.

601–612 Factory Only.

613–618[2] These are the coefficients (a polynomial that linearizes the raw flow data so the display, and the 4-20mA outputs are linearly proportional to the flow rate). Do not change these values unless the Factory authorizes (such as, to extend the calibration curve).

619 Filter Coeff—The filter coefficient is used to smooth out the flow signal (a value of 0.1000 is normal). For example, if you have an unusually turbulent flow, perhaps a pulsating flow, you may want to smooth out the reading and output by lowering the value (if you lower it, it smooths [or averages]) the flow reading as well as the output. To speed up the flow response, increase the value. The speed of response is limited by the thermal response of the sensor (maximum of 1 second per time constant on a step change).

620–638 Relays (See pages 52 & 53).

701[1] Chan Sel—Selects Channels A–D (assuming meter is calibrated for more than one channel). If "4" selected, then channel can be selected externally (unless item 720 is set to 1). For SIG and SRG Series, connect 16 to 17 for Channel B, 15 and 17 for Channel C, both for Channel D, and no connection for Channel A. (If "A" displayed in top left corner of display, then meter is in "External Mode", otherwise blank.)

702 Sample Rate—This setting changes the update period of the display, as well as the 4-20mA output. Low Value=Fast; High Value=Slow (10 is the default=200 msec).

703 Serial Number—Display the Meter Serial Number (the value cannot be changed). Note, the Serial Number displays for approximately 2 seconds upon Meter power-up during the initializing phase. The Serial Number can also be displayed during normal (flow) operation by depressing the "Back/Down" button.

704 New Passcode—allows the user to modify the Passcode from the factory default "99999". CAUTION: If you change the passcode, you must store the new passcode in a safe place. If you forget this new passcode, there is no "back door" to make any further menu changes in the field.

705 Time—Sets the current time of day (in 12 hour or 24 hour format). Use the same format convention as the previous value.

706 Date—Sets the current date. Use the same format convention as the previous value.

707 Back Lighting—The factory default is "0"=Auto (the back lighting comes on for 1 minute with any key press). Change value to "1" in order to keep the back lighting on. (Note: In the SIG and SRG Series, the back lighting can consume as much as 100 mA.)

708 Factory All—Restores the original factory settings for all items on all channels (Channels A–D).

710 Format EEPROM—Factory Only.

711 Back up EEPROM—Factory Only.

712 SDB PreCharge—Factory Only.

720 External Zero Enable—Clears the totalizer (resets to a value of 0) when External Select C terminal is grounded, unless item 701 is set to 4. (See Terminal Hook-up for SIG, SRG.) Note, when the totalizer requires more than 7 digits (including a decimal), it will automatically take precedence over the temperature display. The entire temperature display will blank out, allowing all 12 digits to display. Beyond 12 digits, the totalizer will "roll over" to zero (0). Item 720 allows you to manually reset the totalizer to zero (0). ***Note: To disable totalizer, enable item 720 and jumper to ground External Select "C" Terminal (see page 17).***

730 Power Splash—Provides custom text upon Start Up.

735 Engineering Units Mode—Provides custom engineering units (contact Factory for assistance to avoid conflicts between Flow Rate Display and total).

740 Meter Address—Factory Only.

750 Passcode—Factory Only.

1 The Totalizer, as well as Trip High and Trip Low Values (items 510 to 522) need to be reset if the channels are changed (see Menu items 307 and 530) if you want to clear those readings.

2 **NOTE:** do not round off any newly supplied coefficients when entering. Although all the digits will not be displayed, they will be required by the software calculations. Do not use the keypad for entering coefficients, since some of the least significant digits will be lost.

Detailed Keypad Navigation and Menus

(SEE PAGE 46 FOR SIMPLIFIED KEYPAD INSTRUCTIONS)

POWER-UP

On Power-up:

First screen = "Initializing System"; next = "Sage Metering SNxxxxxx"; then FLOW METER Display which consists of: Flow Rate (top line); Temperature and Totalized Flow (bottom line). Top line may also display the following Status Symbols (!, <, >, B, C, D) described in "SYMBOLS")

During FLOW METER Display:

- Press FLOW/SHIFT to bring up first Menu *(MAIN MENU),* and repeat for other Menus *(DISPLAY OPTIONS,* etc). Menu titles are on the top line, Items are on the bottom line — see page 46–47 for details [to return to FLOW METER Display, Press and Hold FORWARD/UP, then Press FLOW/SHIFT]
- Press FORWARD/UP or BACK/DOWN to scroll through Items on the bottom line [to return, Press and Hold FORWARD/UP, then Press FLOW/SHIFT]
- Press SELECT/SET to preview the Contents of an Item (to scroll through other Item Contents, press FORWARD/UP or BACK/DOWN) [to return, simply Press FLOW/SHIFT]

TO CHANGE VALUES OF MENU ITEMS

During FLOW METER Display:

- Press SELECT/SET to bring up *"Enter Passcode".* Blinking character indicates NUMERIC-ENTRY mode
- Enter the factory default Passcode of 99999 (Easiest Sequence: Press Back/Down, then Select/Set, repeat five times, then Select/Set to unlock the meter).
- If wrong Passcode, it "asks" again — Select/Set to reenter, or to return to FLOW METER Display, Press and Hold FORWARD/UP, then Press FLOW/SHIFT
- Press FLOW/SHIFT repeatedly to bring up desired Menu (to return to FLOW METER Display, Press and Hold FORWARD/UP, then Press FLOW/SHIFT)
- Press FORWARD/UP or BACK/DOWN to scroll through Menu Items (to return to FLOW METER Display, Press and Hold FORWARD/UP, then Press FLOW/SHIFT)
- Press SELECT/SET to preview the Contents of an Item (note blinking characters, since meter is unlocked)
- Make changes as needed. See "NUMERIC ENTRY MODE" to accept change
- Note: You can change Max Value (Item 210) higher than the original Full Scale (FS) calibration range, but accuracy may be effected.

NUMERIC ENTRY MODE

- FLOW/SHIFT: In NUMERIC-ENTRY mode press to move the cursor to the left (value "accepted" when character no longer blinks [to return to FLOW METER Display after value accepted, Press and Hold FORWARD/UP, then Press FLOW/SHIFT])
- SELECT/SET: In NUMERIC-ENTRY mode, press to move the cursor to the right (value "accepted" when character no longer blinks [to return to FLOW METER Display after value accepted, Press and Hold FORWARD/UP, then Press FLOW/SHIFT])
- FORWARD/UP: During NUMERIC-ENTRY mode, press to scroll through numbers and symbols
- BACK/DOWN: During NUMERIC-ENTRY mode, press to scroll through numbers and symbols

COMMON SHORTCUTS

- To return to FLOW METER Display from Menu (Top Line), Press and Hold FORWARD/UP, then Press FLOW/SHIFT. (Only works if a Menu is on Top Line.)
- To return to FLOW METER Display from Item (Top Line), Press FLOW/SHIFT (unless in Numeric Entry)
- To view Serial Number when in FLOW METER Display, Press BACK/DOWN
- Range Changing Shortcut depends on Meter Revision Number. See page 59, "Range Changing Shortcut" for details.
- To change Display Contrast, Hold FLOW/SHIFT as meter is being powered up. The Display Contrast Menu will come up.
- Power Down to Reset — See "POWER UP"

SYMBOLS

- ! = Output Locked; < = Below Flow Cut Off; SDB? = Sensor Driver Board has lost communication (possibly a board is loose, or a component has failed); >Exceeds Full Scale Setting; ^ = Relay On; B, C, D = Selected Channel. Note: If in External Mode (see item 704), the "A" will appear when Channel A is selected. Otherwise Channel A will have no symbol.

Pulsed Outputs, Alarms, Relays and Timer Settings[1]

(NOTE: RELAYS MUST BE PROGRAMMED USING VIP, RATHER THAN THE KEYPAD)

MENUING ITEMS		FUNCTIONS	
620	RELAYS	630	Disable
621	Set RY#1 Off	631	Trip High Flow
622	Set RY#1 On	632	Trip Low Flow
623	Set RY#2 Off	633	Trip High Temp
624	Set RY#2 On	634	Trip Low Temp
		635	Total Delta
		636	Timer
		637	Keypress
		638	Delay Time

Setpoints or timer functions #630-638 may be adjusted only after they are assigned to relay contacts #621-624. First select Relay #1 or Relay #2 and the desired coil activation, On or Off. Each relay selection requires a function for proper operation. It is required that users program the relay settings in sequence #621..#624 and assign functions to each setting. If a relay will be unused, assign #630 (Disabled) to the Relay On and Relay Off setpoints.

ALARM FUNCTION OPERATION

Disable—Used to ignore any alarm conditions or latch a relay contact until reset with powerup.

Trip High Flow—User must enter the Flow Rate the meter will activate if greater than or equal to the entered value.

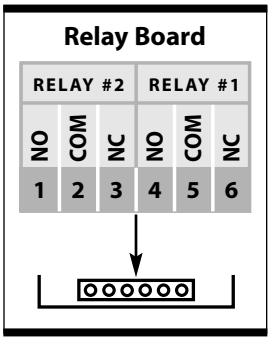
Trip Low Flow—User must enter the Flow Rate the meter will activate if less than or equal to the entered value.

Trip High Temp—User must enter the Flow Temperature the meter will activate if greater than or equal to the entered value.

Trip Low Temp—User must enter the Flow Temperature the meter will activate if less than or equal to the entered value.

Total Delta—User must enter the Flow Total Difference to activate if equal to the entered value. Totalizer is not reset, but an internal counter resets and increments to prepare for next activation condition.

Timer—User enters a timer value which is 20 milliseconds x value in duration to activate a relay condition regardless of flow or temperature. Value can be in the range of 1-65000 to yield .02-1300 seconds. Use to latch an alarm condition with auto-timeout reset.



Keypress—Meter will activate alarm/relay on manual press of the Keypad UP button. Use to change an alarm condition while meter is in Flow Display mode.

Delay Time—User must enter a value to set hysteresis trip time value. All relay trip settings require this value (see Timer for values and range) for proper operation. The trip condition must exist for at least Delay Time value, before the Trip condition will activate. This is used to minimize the effects of false triggering of the alarms from spurious peaks in flow or temperature.

EXAMPLES

NOTE: The steps in setting the Relay Menu items needs to be followed in the exact sequence for Relay Settings to function properly, as noted in the examples below.

Example 1: DEACTIVATE RELAY(S)

Relay #2—Enter Menu item #623 to assign a new function. Enter #630 (Disable) for function assignment. Next Enter item #624 for next function assignment. Then enter #630 (Disable) to keep the relay coil from activating from any alarm condition.

Example 2: TRIP HIGH

Relay #1—Trip on high flow of 1000 SCFM for more than 1 second, then latch and hold until UP button on the keypad is pressed—Enter #621 for function assignment. Enter #637 (Keypress). Enter #622 to set the coil activation condition. Enter #631 (Trip High Flow) and enter 1000 when prompted. Enter #638 (Delay Time) to set hysteresis trip time. Then enter 50 when prompted. (50 x .02sec = 1sec)

Example 3: PULSED OUTPUT OF TOTALIZED FLOW

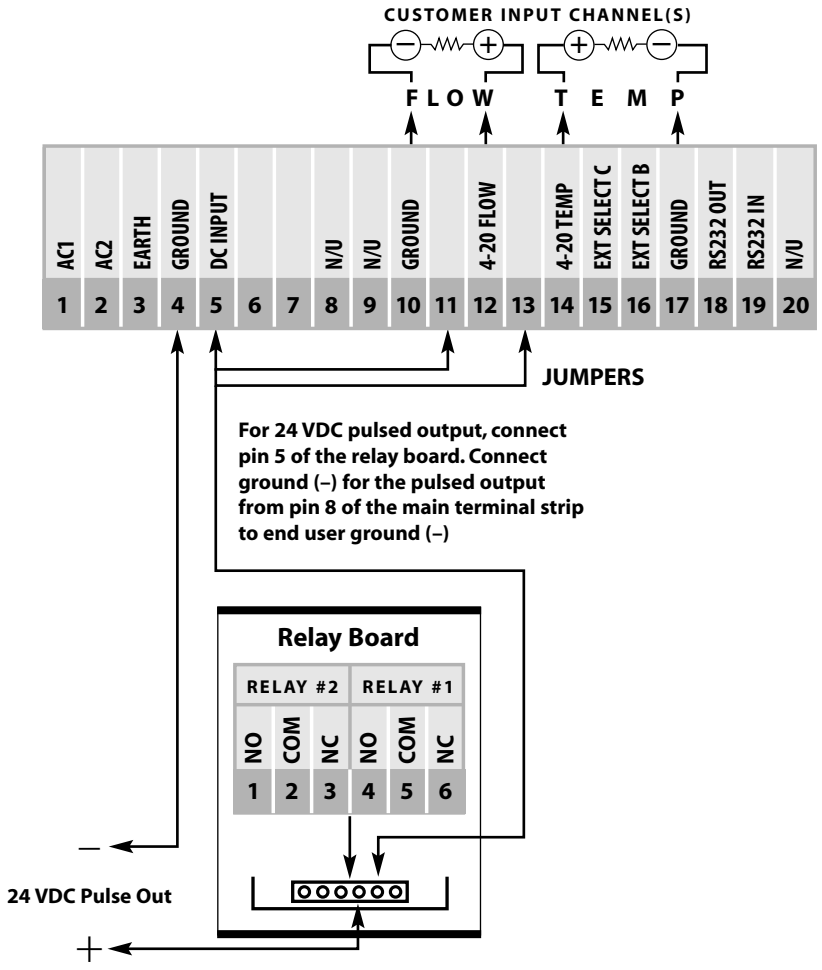
Relay #2—Trip relay on for .5 sec every 100 SCF accumulated in totalizer—Enter #623. Then #636 to set auto timer function to deactivate the relay coil. Enter 25 when prompted to assign .5sec to relay function. Enter #624 then enter #635 and 100 when prompted. Enter #638 (Delay Time) to set hysteresis time. Then enter 1 when prompted for minimum trip time setting. (For Relay #1, substitute 621 for 623 and substitute 622 for 624 in above example.) Note: It is best to use NO (normally open) for the above "accumulate total" (pulsed output) example *(see page 53 for wiring).*

1 Before powering down flow meter, Type 100 at the prompt to "Save" settings.

Wiring for Pulsed Output

1. For 24 VDC pulsed output, 24 VDC is available from the flow meter main terminal strip.
   A. Connect pin 5 of the main terminal strip to the relay board
   B. Connect ground (–) for the pulsed output from pin 4 of the main terminal strip to end user ground (–) pulsed input
   C. Connect pin 4 of the relay board to end user, +24 VDC pulsed input
   D. **SELF-POWERED (Internally Powered) 4-20mA (Factory Default)** Sage supplies the power. In this mode ***outputs are not isolated from DC ground.*** *(See wiring diagram below.)*

2. To set up or change the pulsed output, see page 52 of the User Manual.



Common Examples Using the Keypad (ASSUMES METER IS ALREADY POWERED UP)

Example 1:
Viewing Menus and Items
(Refer to Pages 46–50 of User Manual)

1. Verify that meter is in Flow Mode. (Flow Mode: i.e., meter will be displaying current Flow Rate in top line, Temperature and Total in bottom line)
2. Press Flow/Shift to view Main Menu
3. Press repeatedly to view additional Menus
4. Press Select/Set to view the Items and their Contents
5. Press Forward/Up to scroll Items and their Contents forward
6. Press Back/Down to scroll Items and their Contents backward
7. Press Select/Set to toggle out of Contents, of Item
8. Press Forward/Up to scroll Items forward
9. Press Back/Down to scroll Items backward
10. Press Select/Set to view Contents of Item
11. Press Select/Set again to toggle out of Contents
12. To Shortcut back to Flow Mode, see Example 2

Example 2:
Shortcut into Flow Mode

1. Verify that one of the Menus is on the top line
2. If in View Mode, Press Select/Set. If Menu is not on the top line, Select/Set will toggle the Menu in and out of the top line (when Menu is on top line, the Item is on bottom line. When Menu is not on top line, the Item goes to top line, and the Item Contents goes to bottom line)
3. If in Numeric Mode, See Step 14 of Example 3
4. Press and Hold Forward/Up then Press Flow/Shift. (In other words, as long as the Menu is on the top line, at any time you can hold Forward/Up with one finger, then Press Flow/Shift with another finger to Shortcut back to Flow Mode)
5. After one minute of inactivity, the meter will also go into Flow Mode
6. If the power is cycled off and on, the meter will also go into Flow Mode (after a few seconds of Initializing)

Example 3:
Entering the "99999" Passcode and Changing Item Contents

1. Verify that meter is in Flow Mode. (Flow Mode: i.e., meter will be displaying current Flow Rate in top line, Temperature and Total in bottom line)
2. If not, refer to Example 2
3. Press Select/Set
4. Press Back/Down
5. Press Select/Set
6. Repeat Steps 3 & 4 four times
7. Press Select/Set one more time (meter is now unlocked)
8. Press Flow/Shift to bring up Display Options
9. Press Flow/Shift to bring up Flow Basics
10. Press Flow/Shift repeatedly to bring up additional Menus
11. Press Forward/Up to scroll Items forward. Press Back/Down to scroll Items backward
12. Press Select/Set to accept Item (which puts the meter into Numeric Entry Mode)
13. Forward/Up Button increases numbers. Back/Down Button decreases numbers. Select/Set Button advances cursor. Flow/Shift Button moves cursor one space to the left
14. To Exit Numeric Entry Mode, move cursor left or right (see step 13) until meter is out of numeric entry mode (Menu will be on top. Item will be on bottom).
15. Repeat Steps 10 through 14 as needed for additional entries
16. To go back into Flow Mode, see ***Example 2: Shortcut into Flow Mode.***

Example 4:
How to View Average Flow Rate for Last Hour

1. Verify that meter is in Flow Mode
2. If not, refer to Example 2
3. Press Flow/Shift five times (bring up Analysis Menu)
4. Press Select/Set, (brings up Average Flow Rate for last hour)

5. Press Select/Set to toggle back to the Analysis Menu
6. Shortcut back to Flow Mode, see Example 2

Example 5:
How to View High Flow Rate and its Date and Time stamp

1. Verify that meter is in Flow Mode (see Example 2)
2. If not, refer to Example 2
3. Press Flow/Shift five times (brings up Analysis Menu)
4. Press Forward/Up five times
5. Press Select/Set, (brings up Highest Flow Rate that the meter "has seen" since the last "Clear Data"
6. Press Forward/Up, (displays the Time stamp of the Highest Flow)
7. Press Forward/Up, (displays the Date stamp of the Highest Flow)
8. Press Select/Set to toggle back to the Analysis Menu
9. Shortcut back to Flow Mode, see Example 2

Example 6:
How to View the Meter's Full Scale (Max Val)

1. Verify that meter is in Flow Mode
2. If not, refer to Example 2
3. Press Flow/Shift two times (brings up Display Options Menu)
4. Press Forward/Up twice (brings up Max Val Items)
5. Press Select/Set to bring Up Max Val (corresponds to 20mA)
6. Press Select/Set to toggle back to the Display Options Menu
7. Shortcut back to Flow Mode, see Example 2

Example 7:
How to Change from SCFM to SCFH

1. Refer to Example 3, Steps 1–7 to enter Passcode
2. The Main Menu will appear
3. Press Flow/Shift three times to bring up Eng'g Units Menu
4. Press Back/Down three times (brings up Hour)
5. Press Select/Set to accept
6. Shortcut back to Flow Mode, See Example 2.

Example 8:
Configuring for a Specific Pipe

For this example, assume you have a single channel meter (Channel A only) that is calibrated for 0–25,000 SFPM of Compressed Air

For example, to use the meter in a 4" pipe, follow the steps below (assume keypad)

1. Refer to Example 3, Steps 1 -7 to enter Passcode
2. Use Flow/Shift Key to bring up Flow Basics Menu (Press Flow/Shift twice until you cycle to that Menu)
3. Press Forward/Up twice until Pipe Area item appears
4. Select Set to go into numeric entry
5. Change pipe area from 1.000 to 0.0884 (see Probe Insertion Guidelines for the pipe area for a 4" pipe which is .0884 sq ft)
6. Use Flow/Shift or Select/Set Button to move cursor to left or right until the Flow Basics Menu reappears on top line
7. Press Flow/Shift key to bring up next menu which is Engineering Units (assume you want units of SCFH)
8. Use the Forward/Up key and select Select/Set SCF
9. Use the Forward/Up key (or Back/Down key) and select Select/Set Hour
10. Shortcut out (Hold Forward/Up key then toggle Flow/Shift key)
11. Follow Probe Insertion Guidelines to insert the meter into center of a 4" pipe

Example 9A, 9B, and 9C:

Selecting Channels

If a user simply wants to pre-configure his meter for three or four pipe configurations, then it is a simple matter of selecting the channel he is interested in by changing the value of item 701 (Chan Select) in the System Setup Menu. If on the other hand, the user wants a generic meter, calibrated for Velocity Units, then the user needs to change Pipe Area by changing the value of item 305 (in sq. ft.) in Flow Basics Menu. Subsequently user can change the engineering units (See Menu 400). In some cases, both approaches can be put in a single meter. For example, Channel A, B and C can be "pipe-specific", and Channel D can be in velocity units. Then you can use both procedures. However, the example below assumes four pipe-specific ranges

For this example, I will assume the following four (4) ranges (all Compressed Air at ~100 psig):

Channel A: 0–600 SCFM in a 2" Sch 40 Pipe

Channel B: 0–2000 SCFM in a 4" Sch 40 Pipe

Channel C: 0–5000 SCFM in a 6" Sch 40 Pipe

Channel D: 0–8500 SCFM in an 8" Sch 40 Pipe

Example 9A (Current Version):

To select a channel on Meter Rev. 2.066 (for example, Channel B) from the Keypad, follow the steps below:

1. Verify that Meter is in Flow Mode (see Example 2)
2. Tap the Back/Down Key 4 times (in under 3 seconds)
3. Tap Flow/Shift for Channel A, Select/Set for Channel B, Forward/Up for Channel C, or Back/Down for Channel D
4. It will take about 10 seconds to switch channels after step 3

Example 9B (Older Version):

To select a channel on Meter Rev. 2.065 (for example, Channel B) from the Keypad, follow the steps below:

1. Verify that Meter is in "Flow Mode" (see Example 2)
2. Tap the "Back/Down" Key once
3. Tap "Flow/Shift" for Channel A, "Select/Set" for Channel B, "Forward/Up" for Channel C, or "Back/Down" for Channel D
4. It will take about 10 seconds to switch channels after step 3

Example 9C (Oldest Version):

To select a Channel on Meter Rev. 2.064 or earlier (for example, Channel B) from the Keypad, follow the steps below:

1. Press Select/Set key to enter Passcode
2. Enter 99999, then accept (Enter) to Unlock Menuing System. *(See Example 3, if necessary.)*
3. Use Flow/Shift Key to bring up System Setup Menu (Press Flow/Shift repeatedly until you cycle to that Menu)
4. Chan Sel Item will appear. Select it (by pressing Select/Set)
5. Enter "1" for Channel B. (Flow/Shift moves cursor to left to accept numeric entry)
6. Shortcut out (Hold Forward/Up key then toggle Flow/Shift key)
7. It will take about 10 seconds to switch channels after step 6

Example 10:

Monitoring the Sensor's Raw Milliwatts (RTD Power)

1. Assumes you are already in the correct Channel (See example 9 if you have a Multiple Channel meter)
2. Verify that meter is in Flow Mode
3. If not, refer to Example 2
4. Press Flow/Shift five times (brings up Analysis Menu)
5. Press Forward/Up twice (brings up RTD Power)
6. Press Select/Set once
7. You are now observing the raw milliwatts (mw) coming off the sensor circuit
8. If you want to invoke the Sensor Functionality Zero Calibration Self Check, merely check the observed reading (after a few minutes of "no flow" stabilization), against the next to last line(s) of your Meter's Certificate of Conformance

9. A value within about 3 milliwatts of the original Factory value (assuming the same gas is checked at same pressure) strongly suggests that the meter is still in calibration, and that the sensor does not need to be cleaned

Example 11:

Sensor Functionality and Zero Calibration Self Check

1. Assumes you are already in the correct channel (See example 9 if you have a Multiple Channel meter)
2. Verify that meter is in Flow Mode
3. If not, refer to Example 2
4. Verify that meter has no gas flow. Close appropriate valves in the process to have a "no flow" condition so you can check the "live zero" mw output of the actual gas (it should be checked at the same pressure as noted on Certificate of Conformance). Optionally, do an Ambient Air check by removing probe and covering up sensor by capping the sensor with a plastic bag or other means of preventing flow
5. Press Flow/Shift five times (brings up Analysis Menu)
6. Press Forward/Up twice (brings up RTD Power)
7. Press Select/Set once
8. You are now observing the raw milliwatts (mw) coming off the sensor circuit. Check the observed reading (after a few minutes of "no flow" stabilization), against the last line(s) of your Meter's Certificate of Conformance
9. A value within 5 milliwatts of the original Factory value (assuming the same gas is checked at same pressure) strongly suggests that the meter is still in calibration, and that the sensor does not need to be cleaned (see page 44 for more details)

Example 12:

Factory All (Restore Original Factory Settings)

1. Verify that meter is in Flow Mode. (Flow Mode: i.e., meter will be displaying current Flow Rate in top line, Temperature and Total in bottom line)
2. If not in Flow Mode, refer to Example 2
3. Refer to Example 3, Step 1-7 to enter Passcode
4. The Main Menu will appear
5. Press Flow/Shift seven times to bring up System Set up Menu
6. Press Forward/Up seven times to bring up Factory All Item
7. Press Select/Set Once
8. Press Forward/Up Once
9. Press Flow/Shift Twice
10. Press Select/Set Again
11. Within 30 seconds, the Original Factory Settings will be restored
12. You will note that the Totalizer now reads 0

Range Changing Shortcuts

FOR REVISION 2.066 OR LATER

If you ordered a meter with multiple channels, use the following procedure:

- Tap the last keypad (Back/Down) four times in rapid succession (in under 3 seconds)
- When the Serial Number is displayed, tap any of the 4 keypads as noted in the following steps
- The first keypad (Flow/Shift) will bring up Channel A
- The second keypad will bring up Channel B
- The third keypad (Forward/Up) will bring up Channel C
- The fourth keypad (Back/Down) will bring up Channel D
- Wait approximately 10 seconds for the new Channel to appear
- **Note:** Channels B, C and D display that letter in the top left corner of the display
- **Note:** Channel A will be blank in the top left corner
- Channels can be changed back and forth at any time
- **Note:** The shortcut will only apply to those Channels that are active (i.e., if you ordered a 3-Channel meter, A, B, and C, then you would be able to switch to A, B, or C Channels, but any effort to switch to D will be ignored) unless you specified additional Channels upon ordering, those channels will not be active

Examples Using the Laptop[1]

Example 1:
Changing a Generic SFPM to an SCFM Meter for a 4" Pipe Using Sage VIP

The previous changes could also be done with the Sage VIP and a Laptop. However, in this example, assume that the meter has only one range (Channel A), but is set up as generic velocity meter, in units of 0-25,000 SFPM. You decide to use the meter in a 4" pipe, and want units of SCFM instead of SFPM.

1. Open up Sage VIP
2. Press Space Bar
3. Type in 100 (at the prompt) so the flow is running (Flow Mode). Initially units will be in SFPM
4. Press Space Bar
5. Type in 99999 and Enter to unlock the meter (the text will say "Channel A Active" once it is unlocked)
6. Type in 300 to bring up Flow Basics Menu
7. Type in 305 to bring up Pipe Area
8. Change pipe area from 1.000 to 0.0884 (see Probe Insertion Guidelines for the pipe area for a 4" pipe which is .0884 sq ft)
9. Type in 400 to bring up Engineering Units
10. Type in 406 and Enter for SCF
11. Type in 422 and Enter for Minutes
12. Type in 100 to complete process. Note, meter is now in SCFM units
13. Follow Probe Insertion Guidelines to insert the meter into center of a 4" pipe

Example 2:
Changing Channels using Sage VIP

To change channels from Sage VIP (our navigational software) with the laptop, there is a shortcut:

1. First be sure that the meter is reading Flow (press space bar, then select 100 at the prompt, to bring up Flow Mode)
2. Type uppercase B. It will switch to channel B within 10 seconds
3. To switch to another channel, for example, C, type upper case C

Example 3:
Changing Channels Externally

Finally, the channels can be switched externally, by contact closure, using a switch, a PLC, or a relay (see item 701 on page 47, and enable external switching by selecting "4" in item 701). The description in item 701 (on page 50) also denotes which terminals to connect to.

Example 4:
Dual Channel/Dual Sensitivity Meters and Auto Ranging

Note: Some customers order dual channel/dual sensitivity meters, and using externally latched relays, or a PLC, can autorange between Channel A and Channel B. For example, Channel A on a SRG meter can be ranged for 0-500 SCFM, and have one of the optional relays programmed in Channel A to TRIP HIGH at 450 SCFM, thus sending a contact closure to the PLC. The PLC, in turn, will ground terminal 16 (effectively connecting terminal 16 to terminal 17). That switches the meter into Channel B, which has a range of 0-20,000 SCFM. If the flow falls below 400 SCFM, its relay TRIPS LOW, and the PLC removes the switch closure between Terminal 16 and 17, which causes the meter to switch back to Channel A. So this scheme effectively provides an autoranging meter, and a turndown of 4000 to 1! (5 SCFM to 20,000 SCFM). Alternately external latching relays could also provide the ability to autorange. (Note, in this example, Channel A will be factory configured for a very high sensitivity, by raising the delta T [the overheat] so as to detect even the slighest movement of gas.) Channel B will have a much lower delta T. Thus, when the channels switch back and forth, not only does the calibration range change—so does the delta T (the overheat). **There is no other feature which more clearly defines the concept of "Totally Independent Channels"—for even the overheat changes when the channels switch back and forth.**

1 Note, to unlock the Flow Meter so data can be changed, type in 99999 at the prompt; in a single channel Flow Meter, the displayed text changes from "Chan A Locked" to "Chan A Active", indicating that changes can be made.

Section E

DIAGNOSTICS

Common Diagnostics

SYMPTOM: Erratic Readings.
POSSIBLE CAUSES: If a large Motor or Generator or Variable Frequency Drive (VFD) is nearby the enclosure, it may be inducing sufficient analog noise into the circuitry to temporarily corrupt the data.
SUGGESTED CORRECTIVE ACTION:

a) If a Power-Restart temporarily solves the problem, than it is likely that the source of the noise was the problem.

b) To prevent subsequent problems, if a Remote Style Meter, move the enclosure as far away as possible from the source (the Motor or VFD).

c) If an Integral Style Meter, mount the meter in a different location (further from the source) or move the source further from the meter.

d) The Electronics Enclosure of the SIG and SRG are non-metallic. It may be necessary to install a Sage product that has a Metal Electronics enclosure, such as the Prime (SIP or SRP) or Explosion Proof Series (SIE or SRE).

SYMPTOM: Erratic Readings on a Remote Meter.
POSSIBLE CAUSE: In some cases, analog noise is induced into the Remote cable causing erratic, or climbing readings.
SUGGESTED CORRECTIVE ACTION:

a) Be sure the remote cable is installed in metal conduit and grounded on one end (in some cases, grounding *both* ends may be required).

b) Also, avoid coiled cable, especially if not in metal conduit.

c) Also, if extra cable exists, move the extra cable as far away as possible from any source of analog noise, such as large motors or VFDs.

SYMPTOM: Meter reading zero continuously, or Full Scale continuously, or temperature reading is abnormally low (hundreds of degrees below zero).
POSSIBLE CAUSES/SUGGESTED CORRECTIVE ACTION:

a) It is likely that a wire is loose. But in rare cases, a sensor could fail (i.e., if a standard sensor, HT01 or HT02 sensor exceeds a process temperature of 450˚F.)

b) Check for continuity to be sure the wiring is making good contact at the terminals of the Junction Box.

c) Also, to verify that the electronics and the sensor serial number are the same, note the following: The sensor's serial number will come up upon power up, right after Initializing on the Display. If the serial number doesn't agree with the Junction Box labels, that would affect calibration (in other words, sensors and electronics are a matched pair—mixing them up will cause false readings). Also metal Serial Number Tags are fastened to both the electronics and the Junction Box. They must have identical Serial numbers.

d) To check if a sensor has failed on a remote style meter, it is easy to use the Junction Box to do so. You must Power Down (shut off power), but you do not need to remove the probe from the pipe. Refer to page 19.

e) An Ohm Meter is required to check across the sensor leads of the Flow Sensor. Look at the drawing of the Junction Box. Disconnect the red wires on the Factory Side to isolate and measure the resistance. If the reading is infinity or a short, it means that sensor has failed.

f) Now check the Temperature Sensor. Disconnect the white wires on the Factory Side to isolate and measure the resistance. If you have infinity or a short, it means that sensor has failed. **Note:** *Normally the sensors will read approximately 110 ohms at 70˚ F. At higher temperatures they should read a higher resistance, but both sensors should have a similar value.*

g) On integral style meters (SIG), there is no Junction Box. In that case, refer to the Integral Hookup on page 20 and check the sensor wires. Remove the appropriate wires first (red pair for flow, then white pair for temperature). Measure their resistance. If reading infinity or short, it means that sensor has failed.

SYMPTOM: Meter Railing (Pegging) or Reading High
POSSIBLE CAUSES/SUGGESTED CORRECTIVE ACTION:

a) Insufficient straight run (i.e. flow profile is disturbed, causing errors).

b) Possible jet effect if upstream pipe is smaller than meter flow body or if an upstream valve is too close to the meter.

c) Not following Probe Insertion Guideline.

d) If sensor is inserted in reverse ("Upstream" mark is facing downstream) Meter may over-report (or under-report) by as much as 30%.

e) If sensor is not aligned properly, with "Upstream" mark facing upstream, a rotation greater than ± 5 degrees may cause change in reading (greater than ± 5 degrees and less than ± 20 degrees causes meter to over-report; a greater rotation actually blocks the sensor, and causes meter to under-report).

f) A downstream valve too close to the meter (flow may be reflecting back).

g) Possibly caused by water droplets condensing out of gas stream (which generally causes output to spike; but if droplets are near continuous, output may rail).

h) Meter is miswired, especially in Remote Style application.

i) Possibly caused by water droplets condensing on inside of pipe wall, which roll down or hit sensor causing output to spike; but if droplets are near continuous, output may rail. **Note:** *Recommend installation 45° from vertical (see drawing on page 76).*

j) Possibly caused by water droplets condensing out of gas stream and filling the cavity containing the sensing elements (usually due to probes mounted below horizontal in saturated pipes).

k) Sensor may be contaminated. Remove probe, wipe off or clean with a solvent. Reinsert.

l) Using a different gas or gas mix than the meter was specified and calibrated for.

m) If a Remote Style Meter (SRG), be sure Serial Numbers of Junction Box and Remote Electronics are identical (if not, errors in calibration are inevitable). To confirm, verify that Junction Box Serial Number Tag has identical Serial Numbers to Tag on Remote Enclosure.

n) Meter may appear to be reading high if user is comparing Sage flow meter readings (SCFM) to an uncorrected volumetric device (ACFM). For example, at constant volume, a decrease in gas temperature will increase the mass flow (SCFM). That is completely normal.

SYMPTOM: Reading Low
POSSIBLE CAUSES:

a) Insufficient straight run (i.e. flow profile is disturbed, causing errors).

b) Poor flow profile Upstream (insufficient upstream straight run).

c) Not following Probe Insertion Guideline.

d) If sensor is inserted in reverse ("Upstream" mark is facing downstream) Meter may over-report (or under-report) by as much as 30%.

e) If sensor is not aligned properly, with "Upstream" mark facing upstream, a rotation greater than ± 5 degrees may cause change in reading (greater than ± 5 degrees and less than ± 20 degrees causes meter to over-report; a greater rotation actually blocks the sensor, and causes meter to under-report).

f) Sensor may be contaminated. Remove probe, wipe off or clean with a solvent. Reinsert.

g) Using a different gas or gas mix than the meter was specified and calibrated for.

h) If a Remote Style Meter (SRG), be sure Serial Numbers of Junction Box and Remote Electronics are identical (if not, errors in calibration are inevitable). To confirm, verify that Junction Box Serial Number Tag has identical Serial Numbers to Tag on Remote Enclosure.

i) Meter may appear to be reading low if user is comparing Sage flow meter readings (SCFM) to an uncorrected volumetric device (ACFM). For example, at constant volume, an increase in gas temperature will lower the mass flow (SCFM). That is completely normal.

j) On most models, the Totalizer will not start counting for 10 seconds after power up so any flow data will not be accumulated during this time.

k) Insufficient 24VDC power supply—the SIG & SIP require 350 ma to operate properly, or 250 ma with back lite turned off (Menu item 707)

l) Excessive load on the 4-20 ma. (To check if problem is due to 4-20 ma output device, temporarily remove device, and observe if display reads as expected).

SYMPTOM: Totalizer can take up to 10 seconds to update its reading when flow meter is first powered up, or a channel is changed.
CORRECTIVE ACTION: None. This slight delay is completely normal.

SYMPTOM: Display does not have power
POSSIBLE CAUSE: Mis-wiring

Section F

WARRANTIES AND SERVICE WORK

Warranties and Service Work[1]

LIMITED WARRANTY

Sage Metering's products are warranted against faulty materials or workmanship for one year from the date of shipment from the factory. Sage's obligation is limited to repair, or at its sole option, replacement of products and components which, upon verification by Sage at our factory in Monterey, California, prove to be defective. Sage shall not be liable for installation charges, for expenses of Buyer for repairs or replacement, for damages from delay or loss of use, or other indirect or consequential damages of any kind. This warranty is extended only to Sage products properly used and properly installed for the particular application for which intended and quoted; and does not cover water damage due to improper use of cord grips or removal of protective caps; and does not cover Sage products which have been altered without Sage authorization or which have been subjected to unusual physical or electrical stress. Sage makes no other warranty, express or implied, and assumes no liability that goods sold to any purchaser are fit for any particular purpose. Transportation charges for materials shipped to the factory for warranty repair are to be paid by the shipper. Sage will return items repaired or replaced under warranty, prepaid. NOTE: No items will be returned for warranty repair without prior written authorization from Sage Metering, Inc. Sage does not warranty damage due to corrosion. Sage does not warranty damage due to improper packing for warranty repair. See page 69.

GENERAL TERMS AND CONDITIONS

Detailed General Terms and Conditions can be found on the Sage website (www.sagemetering.com) on a link "General Terms" on the Footer of any page on the website.

CANCELLATION / RETURN POLICY

Cancellation or Return: After issuance of a purchase order (by phone, mail, e-mail or fax) or a credit card order (by phone, mail, e-mail or fax), there will be a cancellation fee for any cancelled order. Cancellations must be in writing (by mail, e-mail or fax):

1) If credit card order or non-credit card order is cancelled within 7 days of issuance of purchase order or date order was placed (which ever is earlier), there will be a 10% cancellation fee.

2) If credit card order or non-credit card order is cancelled after 7 days, but prior to shipment, there will be a 20% cancellation fee. (If order is cancelled due to late delivery, the cancellation fee will be waived. Late delivery is defined as shipping a meter 7 days or later than the delivery date acknowledged by Sage Metering at time of placing order).

3) If a credit card customer decides to return the equipment after shipment for credit, credit will not be issued if equipment is damaged or if equipment is returned after four (4) months of shipment. If equipment is not damaged, then equipment can be returned after issuance of a Return Meter Authorization (RMA) by Sage. **Returned package must be insured by customer and must reference proper RMA# on outside of package**, or package may be rejected (i.e., package will be returned unopened). Credit Card customers will be charged a 30% re-stocking fee (70% balance will be credited back). Customer is responsible for return shipping charges and any damage if improperly packaged.

continued on next page

1 Detailed General Terms and Conditions can be found on the Sage website (www.sagemetering.com) on a link "General Terms" on the Footer of any page of the website.

4) If a non-credit card customer decides to return the equipment after shipment for credit, credit will not be issued if equipment is damaged or if equipment is returned after 1 month of shipment, unless authorized by a representative at Sage Metering, Inc. The Sage representative will issue a Return Material Authorization (RMA) at that time and will advise of the restocking fee. **Returned package must be insured by customer and must reference proper RMA# on outside of package**, or package may be rejected (i.e., package will be returned unopened). Customer is responsible for return shipping charges and any damage if improperly packaged.

RETURNING YOUR SAGE METER

A Return Material Authorization Number (RMA#) must be obtained prior to returning any equipment to Sage Metering for any reason. RMA#s may be obtained by calling Sage Metering at 866-677-7243 or 831-242-2030 between 8:00 am and 5:00 pm Monday through Friday.

A Sage RMA Form (see page 70) must be filled out and included with the meter being returned to Sage Metering. RMA Form is also accessible by clicking the "Contact Tab" of the Sage Website (www.sagemetering.com).

Take special care when packaging your meter for return to the factory. The sensor in particular may easily be damaged if not prevented from shifting around within the package and if the sensor itself is not covered to keep it from contacting other package contents. Any damage resulting from improper packaging is the responsibility of the shipper. It is recommended that a section of PVC pipe be used to protect insertion meters upon their return. Cut a length of PVC at least 1/2" longer than the probe. Insert over the entire probe and properly secure the PVC to the enclosure or junction box (if an SRP). A properly secured and measured PVC section will cover the entire probe as well as the sensor, and will extend 1/2" (or more) beyond the sensor housing.

A purchase order is required prior to an RMA being issued. Most repairs or recalibrations can be quoted over the phone. For equipment that must be evaluated, an Evaluation purchase order in the amount of $150 is required. Once an evaluation is completed and a quote has been issued, you can choose to proceed with the work or have the unit returned with only the evaluation and freight fee billed.

In accordance with the "Right to Know Act" and applicable US Department of Transportation (DOT) regulations, Sage Metering will not accept delivery of equipment that has been contaminated without written evidence of decontamination, and has instituted the following Return/Repair conditions. Strict adherence to these conditions is required. Returned equipment that does not conform to the requirements listed below will not be processed. If Sage Metering finds evidence of contamination, we may, at our option, have the unit returned at your expense. For your reference, the requirements for packaging and labeling hazardous substances are listed in DOT regulations 49 CFR 172, 178, and 179.

1. The equipment must be completely cleaned and decontaminated prior to shipment to Sage Metering. This decontamination includes the sensor, probe, electronics and enclosures internally and externally. All packaging must be clean and free from contamination.
2. A Material Safety Data Sheet (MSDS) is required for all process fluids and gases that have been in contact with the equipment. This includes fluids or gases used in cleaning the equipment. A Decontamination Statement is also required for each meter returned using a different gas or fluid. Both the MSDS and the Decontamination Statement are to be attached to the OUTSIDE of the shipping container. If both documents are not attached, you will be called, and the equipment sent back to you at your expense.
3. The decontamination Statement must include the following required information
   A. A list of all chemicals and process fluids used in the equipment, including decontamination fluids or gases.
   B. The model and serial number of the equipment being returned.
   C. A company officer or other authorized person's signature on the statement.

Return Shipping Address:

Sage Metering, Inc.
8 Harris Court, Building D1
Monterey, CA 93940

RETURN MATERIAL AUTHORIZATION

RMA # _____

Date _____

RETURN CUSTOMER INFORMATION

Customer's Name _____ Fax # _____

Customer's Contact Name _____ Phone # _____

Email Address _____

CUSTOMER'S RETURN ADDRESS

Bill to: _____ Ship to: _____

RETURN PRODUCT INFORMATION

Model No. _____ Serial No(s). _____

FLOW: MIN _____ NORMAL _____ MAX _____

TEMP: MIN _____ NORMAL _____ MAX _____

PRESSURE: MIN _____ NORMAL _____ MAX _____

GAS _____

REASON FOR RETURN / DESCRIPTION OF SYMPTOMS

(All non-warranty repairs could be subject to a minimum evaluation charge)

Recommended steps to be used to duplicate problem/symptoms _____

Sage Metering Technical Contact _____

Take special care when packaging your meter for return to the factory. The sensor in particular may easily be damaged if not prevented from shifting around within the package and if the sensor itself is not covered to keep it from contacting other package contents. Any damage resulting from improper packaging is the responsibility of the shipper.

SAGE METERING, INC.

8 Harris Court, Building D-1 / Monterey, California 93940

PHONE: 831-242-2030 / FAX: 831-655-4965

Section G

APPENDIX

Appendix

CHARACTER LOCATIONS:

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
B[1]			1	8	3	•	7	4	4			S	C	F	M
	1	2	5	F		2	3	5	6	•	9		S	C	F

2	3	4	Flow Rate (max of 3 decimals)[5]		Flow Rate Units[6]	
Temperature[7]			Total (max of 2 decimal places)[8]			Totalized Units[9]

FOOTNOTES:

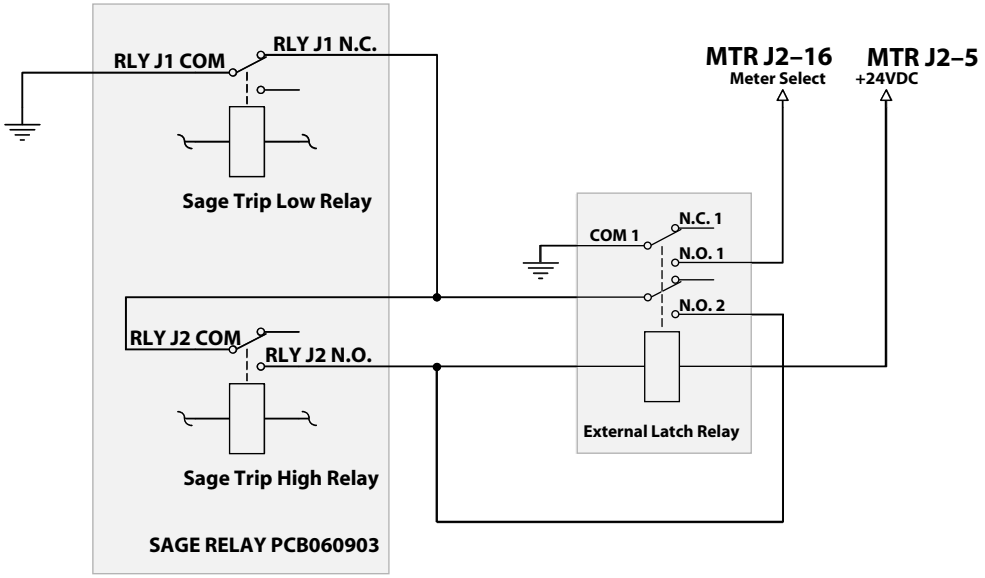
1. Your meter can be configured for up to four channels (A, B, C and D)
2. Channel: If only one channel, the "A" will be blank, unless channels are in external mode; This position also reserved for Relay 2 Status (i.e., Relay On [^])
3. This position reserved for over-range condition (>) and other symbols (see symbols on bottom of page 51). If over-ranged, display will continue, but output still 20ma
4. This position reserved for Relay 1 Status (i.e., Relay On [^])
5. Max 7 digits for flow rate (if no decimals), and always a space between the units
6. See table at right for flow rate units that are available (factory or user selectable)
7. Temperature can have a minus sign (if negative), but no decimals. C or F units (no space). Temperature will blank if needed by Total.
8. Max 7 digits when temp is displayed. Max 12 digits for total (if no decimal and if temperature blank)
9. See table at right for totalized units that are available (factory or user selectable)
10. **Note:** When totalizer exceeds 7 digits, it will take precedence over temperature reading, and blank out the entire temperature reading, allowing 12 digits of total. If this feature is not desired, then disable totalizer per footnote 11 on page 48.

Engineering Units
KG/
LB/
NCM
NMP
SCC
SCF
SFP
SLP
Custom Units
DAY
HOUR
MINUTE
SECOND

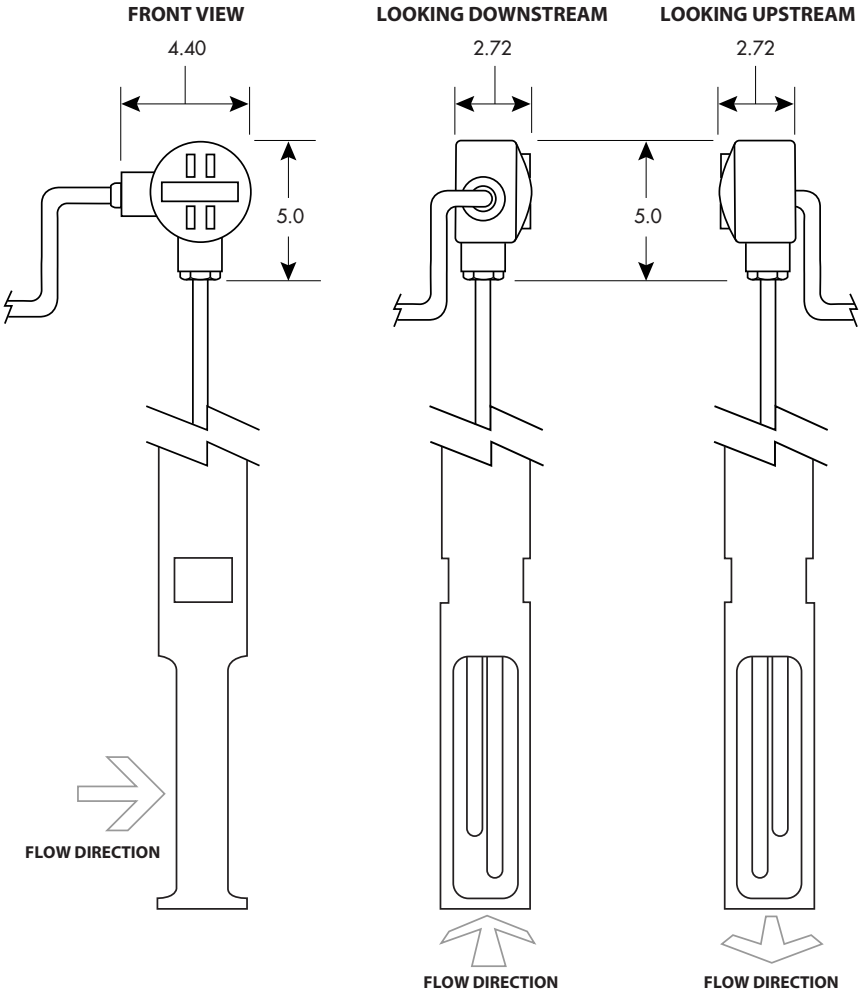
Autoranging

The two Channels (A and B) can be externally selected by grounding the appropriate terminals (Terminal 16 for SRG Series). The external mode is software selectable (Item 701=4). With the relay option, channel A could be set to Trip High when the flow exceeded a certain level to latch an external (user supplied) relay. That external relay could ground Terminal 16 bringing up Channel B ("upset" condition). Then when the upset condition was over, Channel B could have its relay setting set to Trip Low, so as to release the external relay from latched position (will need 2nd ext relay to do this), thus putting meter back in "normal" mode. Such a strategy would effectively be AN AUTORANGING METER: CHANNEL A "NORMAL", AND CHANNEL B "UPSET" CONDITION. However, it is important for user to supply latching relays (see drawing below) or to use their PLC since our internal relays have a setting that resides in the active range. So the relay settings for Channel A (Trip High) are specific to Channel A, and do not apply once meter is switched to Channel B. When switched to B, Channel B (Trip Low) settings apply.

For additional information refer to the following pages: Terminals, page 17 (in particular Terminals 16 and 17); Menu Items, page 47 (Item 701); Menu Item Descriptions, page 50 (Item 701); Examples Using the Laptop, page 59 (Example 3 and especially Example 4).



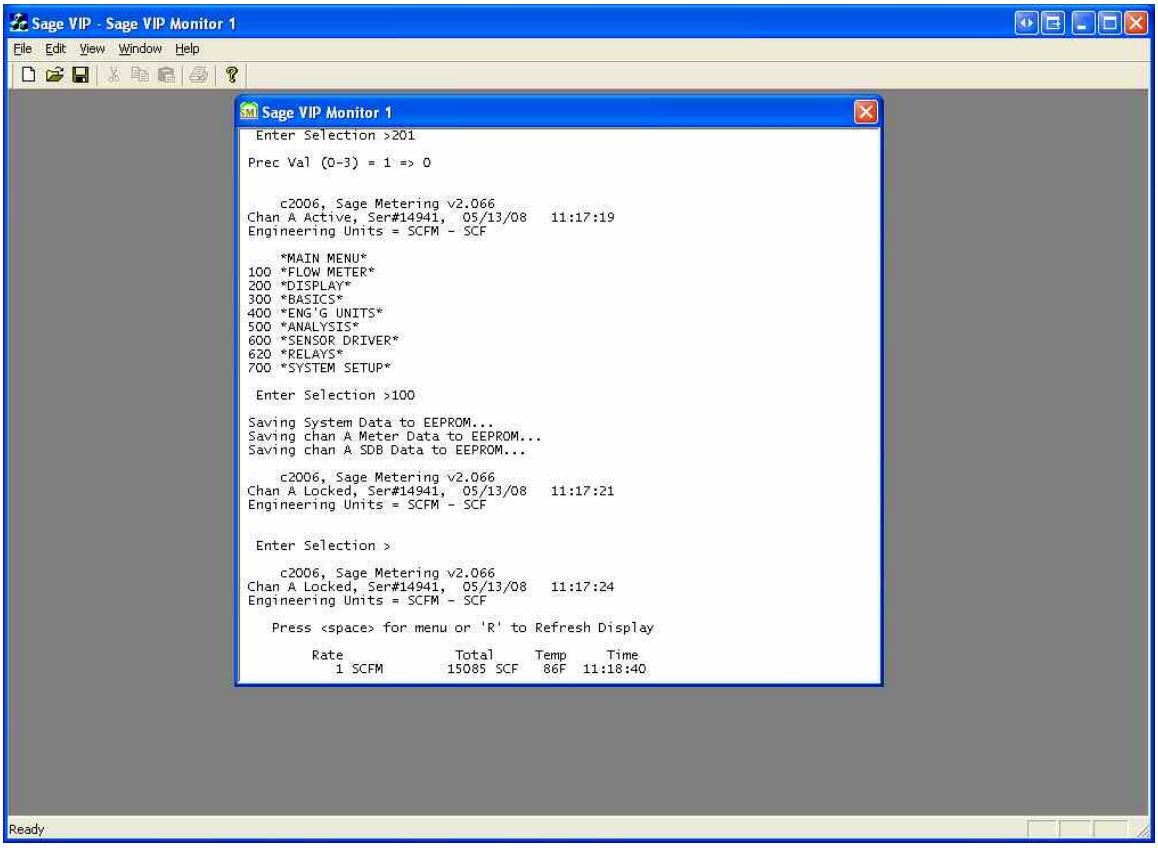
Junction Box and Upstream Orientation



Installations Where Pipe Condensation May Develop

**TILT ENCLOSURE 45º (forward or backward)
FOR APPLICATIONS WHERE
CONDENSATION MAY DEVELOP
ON INSIDE WALL OF PIPES**

Sage VIP Screen Shot[1]



1 See pages 47–50 for actual Menus and Items.

What is a Thermal Mass Flow Meter?

- What is a Thermal Mass Flow Meter? It is a meter that directly measures the gas mass flow based on the principle of conductive and convective heat transfer.

- All Meters have probes (Insertion Style) or Flow Bodies (In-Line Style) that support a pair of sensors, which are in contact with the gas.

- The sensors are RTDs, which are resistance temperature detectors. They consist of highly stable reference-grade platinum windings. In fact, we use the same material that is used as Platinum Resistance Standards at the NIST.

- The RTDs are clad in a protective 316 SS sheath for industrial environments.

- One of the RTDs (See Diagram below) is self-heated by the circuitry and serves as the flow sensor. The other RTD acts as a reference sensor, and measures the gas temperature. Essentially it is used for temperature compensation.

- The Sage proprietary sensor drive circuitry maintains a constant overheat between the flow sensor and the reference sensor. As gas flows by the heated sensor (flow sensor), the molecules of flowing gas carry heat away from this sensor, and the sensor cools down as it loses energy. The circuit equilibrium is disturbed, and momentarily the temperature difference between the heated sensor and the reference sensor has changed. The circuit will automatically (within 1 second) replace this lost energy by heating up the flow sensor so the overheat temperature is restored.

- The current required to maintain this overheat represents the mass flow signal. There is no need for external temperature or pressure devices.